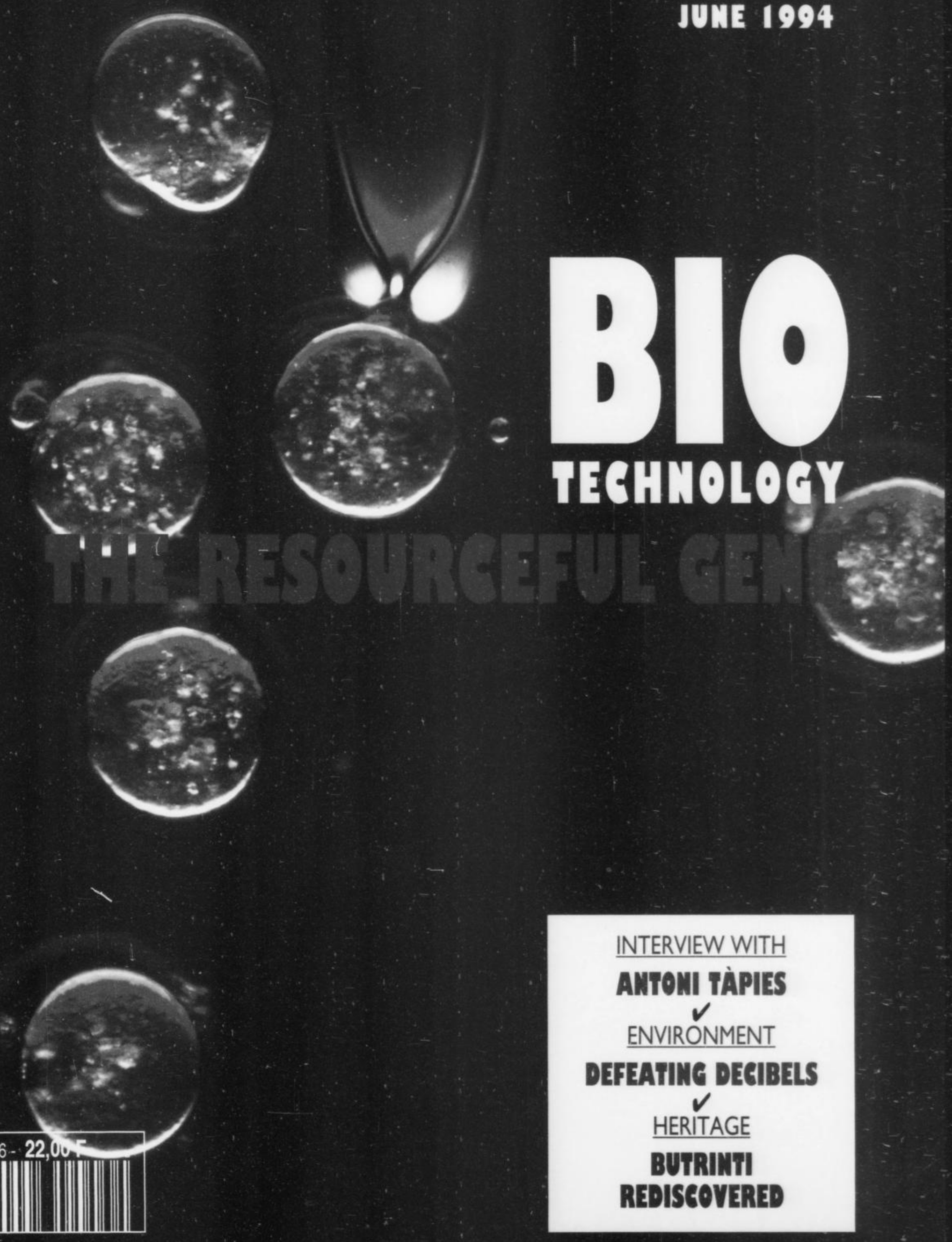
The UNESCO COURIER

JUNE 1994



BIO TECHNOLOGY

THE RESOURCEFUL GENE

INTERVIEW WITH
ANTONI TÀPIES

✔
ENVIRONMENT
DEFEATING DECIBELS

✔
HERITAGE
BUTRINTI REDISCOVERED

M 1205 - 9406 - 22,00 F

From Sarajevo

On the occasion of International Press Freedom Day the Director-General of UNESCO launches an appeal for peace

Let us make this week a historic turning point from a culture of war to a culture of peace!

In South Africa, under the clear-sighted leadership of Nelson Mandela and Frederik de Klerk, elections have been held and apartheid is over. The Middle East, thanks to the farsightedness of Yasser Arafat, Shimon Peres and Itzhak Rabin, is ending the first stage of a new departure towards peaceful coexistence and neighbourliness.

In this one week the spirit of understanding and mutual respect has come to two of the most long-standing and most difficult problems of coexistence. The same thing has happened in El Salvador and Mozambique. I therefore solemnly appeal to all the parties in Bosnia and Herzegovina (knowing full well how recent and deep the wounds are) to halt the fighting and sit down at the table of dialogue and conciliation. You can make this week a historic occasion for peace. In particular I appeal to the Serbian leaders to stop now and take part in peace talks.

From Sarajevo, on the occasion of International Press Freedom Day, I solemnly appeal to all those engaged in conflict, especially fratricidal conflict, to cease hostilities and embark on a dialogue for peace. Peace in justice, equity and freedom.

In Rwanda, Angola and Afghanistan, please realize that everything can be discussed, a solution can be found to every problem, except death! Let there be no more dying for causes that deserve so richly to be lived for!

Today is a great day for hope, and we thank all those who have been at the inception of the processes that are coming to fruition, all those who have been able to overcome their hatred and desire for vengeance and have agreed to turn a page towards the future.

Today from Sarajevo a new song of life and freedom goes forth to the whole world. May the force of reason prevail over the reason of force!

We have not been able to share our past or live in harmony. But we still have intact a common treasure, our future. And this week can be a crucial turning point from war to peace everywhere. From Sarajevo I also appeal to people all over the world to contribute to the reconstruction of this country and to the restoration of its multicultural symbols: the library, the Mostar bridge, the churches and places of worship of every religion, schools of every kind.

We can no longer just sit back and gape in wide-eyed wonder. The time for active solidarity has now begun. Your contribution, whatever the amount, will show that we, especially in Europe, are no longer passive. And that the momentum of love between peoples is the strongest force.

Today is a day of hope. There are examples to follow. Great events to celebrate. On behalf of the United Nations agency mandated to build peace in the minds of men, I ask you to make a gift to all the world's children and young people: lay down your weapons and use your free hands to build a new world based on love.

Federico Mayor

Sarajevo, 3 May 1994

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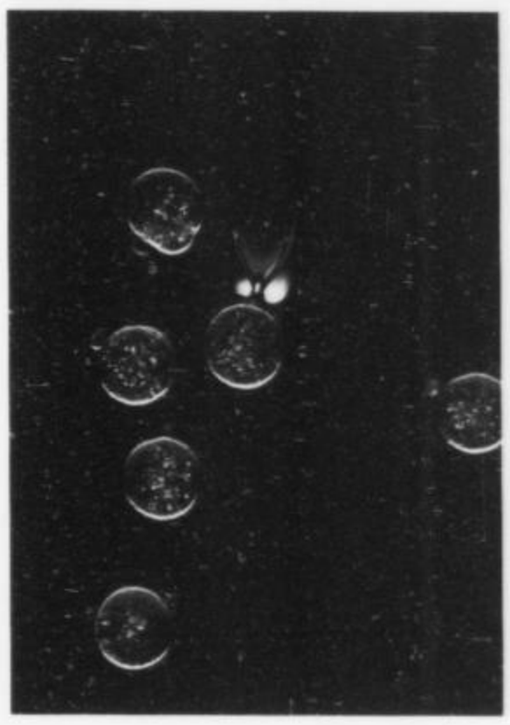

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The UNESCO COURIER

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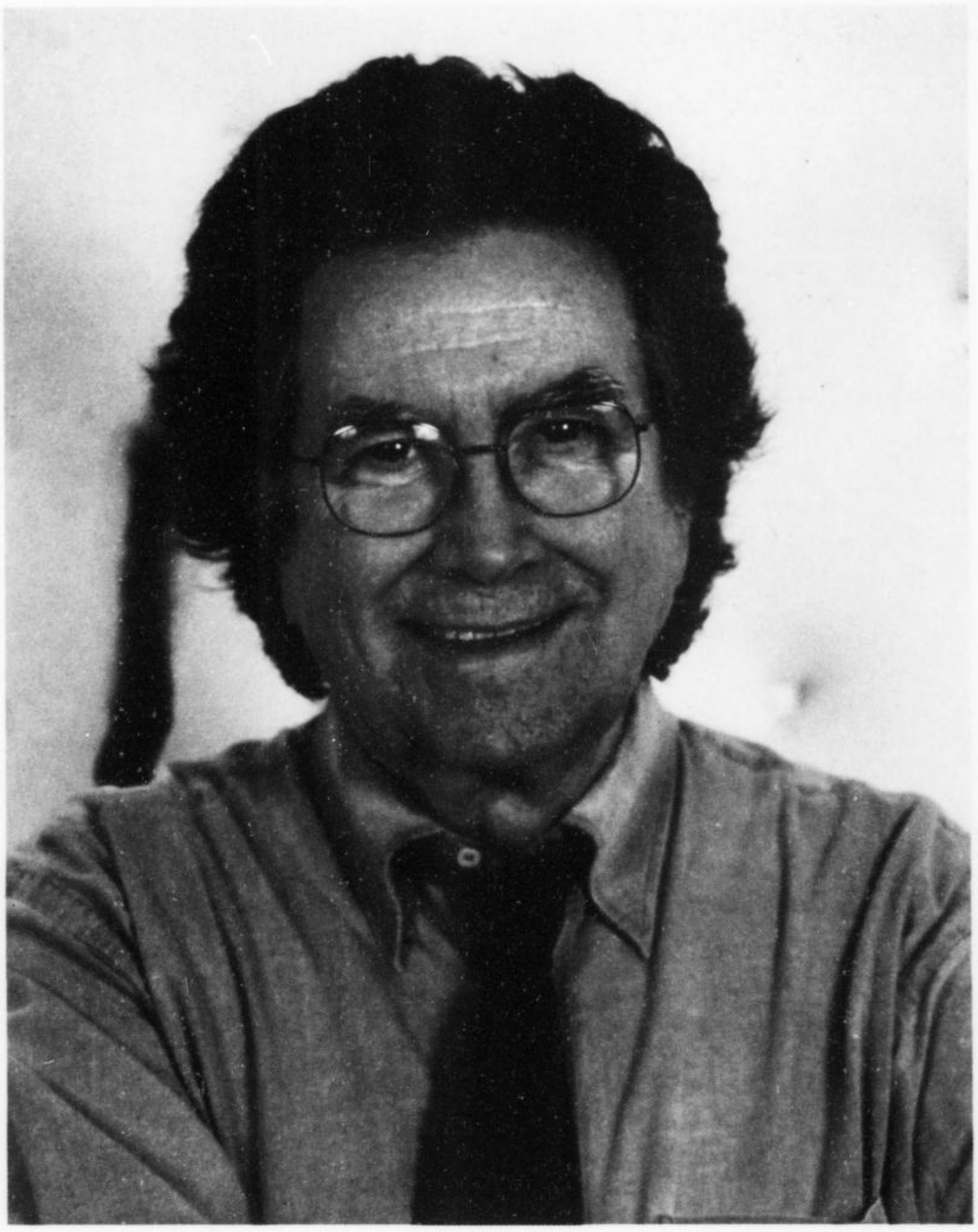
"The Governments of the States parties to this Constitution on behalf of their peoples declare,
"that since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed . . .
"that a peace based exclusively upon the political and economic arrangements of governments would not be a peace which could secure the unanimous, lasting and sincere support of the peoples of the world, and that the peace must therefore be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind.
"For these reasons, the States parties . . . are agreed and determined to develop and to increase the means of communication between their peoples and to employ these means for the purposes of mutual understanding and a truer and more perfect knowledge of each other's lives. . . ."
EXTRACT FROM THE PREAMBLE TO THE CONSTITUTION OF UNESCO, LONDON, 16 NOVEMBER 1945

INTERVIEW

ANTONI TÀPIES

talks to Serafín García Ibáñez

Born in Barcelona in 1923, Antoni Tàpies is one of the greatest Spanish artists of our time. Largely self-taught, he was influenced early in his career by the Dadaists and the Surrealists and then in the 1950s he engaged in the experimentation with informalism for which he became famous. Major museums began to hold exhibitions of his work and in 1958 an entire room was devoted to it at the Venice Biennale. Awards from UNESCO and the Carnegie Foundation testified to his growing international reputation. He has a highly personal way of using materials, constructing his compositions from commonplace and discarded objects — packaging, sand, marble dust, latex, cast iron, rags — mixed with thick impasto and incised with expressive graffiti-like markings. His later assemblages incorporate objects such as buckets, mirrors and even larger items. He has written widely about his art, and a volume of *Conversations with Antoni Tàpies* was published in 1991 (Prestel Verlag, Germany).



■ *You started out as a law student and then abandoned your law studies to devote yourself to painting. Did you take that decision on an impulse?*

— I had an artistic vocation. When I was a child I loved drawing. I lacked the basic skills, but as time went by I became consumed by a desire to do better than all my classmates. My father, who was a lawyer, hoped that I would follow in his footsteps and join his practice. He was so insistent that I actually studied law for five years before dropping it. Then I had the good fortune to win a scholarship awarded by the French Institute in Barcelona which enabled me to go to Paris. Those scholarships were wonderful. They carried no obligations, and although they were not worth very much financially, they provided enough to live on. For me it was an extraordinary stroke of luck.

■ *What sort of person are you?*

— I would say off the cuff that I am an anxious person. I worry about everything. I need to know everything. I tend to live in a state of anxiety with the feeling that life is some kind of great catastrophe. I feel the desire, or rather the intense need, to do something useful for society, and that is what stimulates me. In every situation I always look for what is positive and beneficial for my fellow citizens. I am interested in study, reflection, philosophy—

SERAFÍN GARCÍA IBÁÑEZ
is a journalist with UNESCO's Office of Public Information.

■ One should come to art with an open mind, without searching for references. One should simply listen to one's feelings.

but always as a dilettante. I also consider myself a dilettante as a painter.

■ ***It is hard to reduce art to a formula and one might almost say that everyone has their own definition. What is yours?***
—For me, art is a mechanism, a system that makes it possible to change the spectator's way of looking and to bring him or her closer to a state of contemplation of reality at its deepest level. The artist is like the mystic: each one acts in his own way but their common purpose is to achieve the inner illumination that enables them to perceive the depths of reality. For me this is what art is about.

■ ***What do you mean by "reality", a word you often use?***
—When I talk of reality, I am always thinking of essentials. Profundity is not located in some remote, inaccessible region. It is rooted in everyday life. That is what great thinkers have taught me, above all the philosophers of the Far East, for whom true wisdom—which I am far from achieving—is the conjunction of *samsara* (the ordinary world) and *nirvana* (profound reality). To achieve contact with reality is not to transport oneself elsewhere, it is not transcendence but thorough immersion in one's surroundings. A reality which is neither purely physical nor metaphysical, but both at once.

■ ***Your work is known all over the world but many find it perplexing. Do you think this is because the public is used to figurative art?***
—It is true that the education we receive inculcates certain mental habits. As far as art is concerned, for example, it is generally thought that painting is copying nature, in other words reality in its most superficial form. Today this is the role of photography, the cinema and television. What is called photorealism in painting no longer has any point. Not because it is questionable in itself but because there are other ways of expressing and explaining what it shows us.

■ ***You yourself started out as a figurative painter. . . .***
—Yes of course, just like everyone else. Like the artists of my generation, at any rate. We were attracted by what we have just been talking about: the imitation of nature. I did not attend an academy, I made one for myself, painting the portraits of my friends and forcing myself to control what I wanted to express.

■ ***Does a work of art have a message?***
—Is the medium the message? This is an endless source of debate. The way in which things are presented is one part of the message. Like the most conventional of figurative painters, I could paint a still-life with apples, for example, but I would do it in terms of something else that I wanted to express. I would paint those apples in my own way. Perhaps I would sketch a whirlpool, or a world in movement, an impression of living, organic matter. Painting expresses the painter's way of thinking, his perception of reality. The kind of realism we are talking about is not so far from the work of certain contemporary painters. Today we have other technical possibilities, but some of them are very simple. People think that computers, new machines, the power of technology make it possible to reproduce reality with a high degree of precision. My equipment is extremely modest—it amounts to a brush whose bristles are rather worn. That's all I need. The simplest tools can express the deepest feelings.

■ ***You use very ordinary materials such as cardboard or hessian for your paintings.***
—That too is a message. Materials are expressive. Gold leaf will make a totally different impression on you from that made by a piece of torn cardboard. And the piece of cardboard will have different connotations, and will arouse different feelings from those produced by a piece of polished marble. These commonplace materials, which had been ignored, were exactly what I was looking for. They provoked the spectator and made him think. Perhaps on the spur of the moment he thinks they are rubbish, but when he gives the matter a little thought he sees that there is profound wisdom in the humblest objects. The Japanese say that the whole universe is contained in a grain of sand. These objects, which seem to be nothing but rubbish, can deliver an authentic human message.

■ ***Is it necessary for the artist and his work to be politically, socially or morally committed? Or is beauty sufficient justification for a work of art?***
—I have always thought that the ideological component—the political component even—was necessary. But it has to arise from the artist's general vision and not, as has happened in totalitarian—fascist or communist—countries, from an overtly political discourse. My political commitment results from my way of working. The details naturally take their place on this backcloth. The message, whatever it is, is essential. The person who only paints to amuse the gallery or play the fool must be very unhappy. But, I repeat, the message emerges from the work itself; it is the work that reveals its social, political or philosophical content.

■ ***A message only has meaning if it is understood, and the language of contemporary art is perhaps not within everyone's reach. Is an initiation necessary?***
—I think so. An initiation in the educational sense of the term. Unfortunately, it is a training one must follow when young, for sensibility is formed in childhood. I do not think that educational systems in the West, especially in Spain, are up to it. Art

must be taught at school in order to educate the taste of children and young people, to prevent them from falling into banality. Most people approach art with preconceived ideas: they want to see in it what, as a result of conformism or because they are ill informed, they expect to find in it. One should come to art with an open mind, without searching for references. One should simply listen to one's feelings.

■ *Which painter or painters do you most admire?*

—There are so many of them that it would be boring to give you a list of all of them. I am a collector in a small way and I like to be surrounded by my favourite authors, painters and sculptors. And I am extremely eclectic. I am deeply moved by the great art of Egypt, Chinese painting of the Song and Yuan periods (which has inspired some of our contemporaries) and the works of the great Chinese and Japanese calligraphers. African art and pre-Cortesian and pre-Columbian art as well.

■ *And among Spanish painters?*

—Spanish painting and art cover an immense range. I love the Romanesque style—Catalan Romanesque above all—but also certain features of Gothic art, the mysterious works of Ribera, Zurbarán, and of course Picasso and Miró.

■ *You have left out another Catalan painter, Dalí.*

—Dalí produced some very interesting work in the 1930s. Then he began to do the kind of thing I was attacking a few minutes ago—photo painting. And from an ideological point of view, Dalí ceased to interest me from the time of the Civil War. I was disappointed by his behaviour as a citizen and as a human being.

■ *Do you have any pastimes or hobbies outside painting?*

—I collect books, all kinds of books, old and new. Books that talk of the mysteries of life in every period. I also love listening to music. I am particularly fond of Romantic music: I find Wagner enchanting. But I also appreciate later composers such as Bruckner and Mahler, and even more modern composers such as the Italian Scelsi, whose admirable work is still not widely known. At present his is my favourite music. I also like the modern French composers and some of the Germans, such as Stockhausen.

■ *Do you like flamenco?*

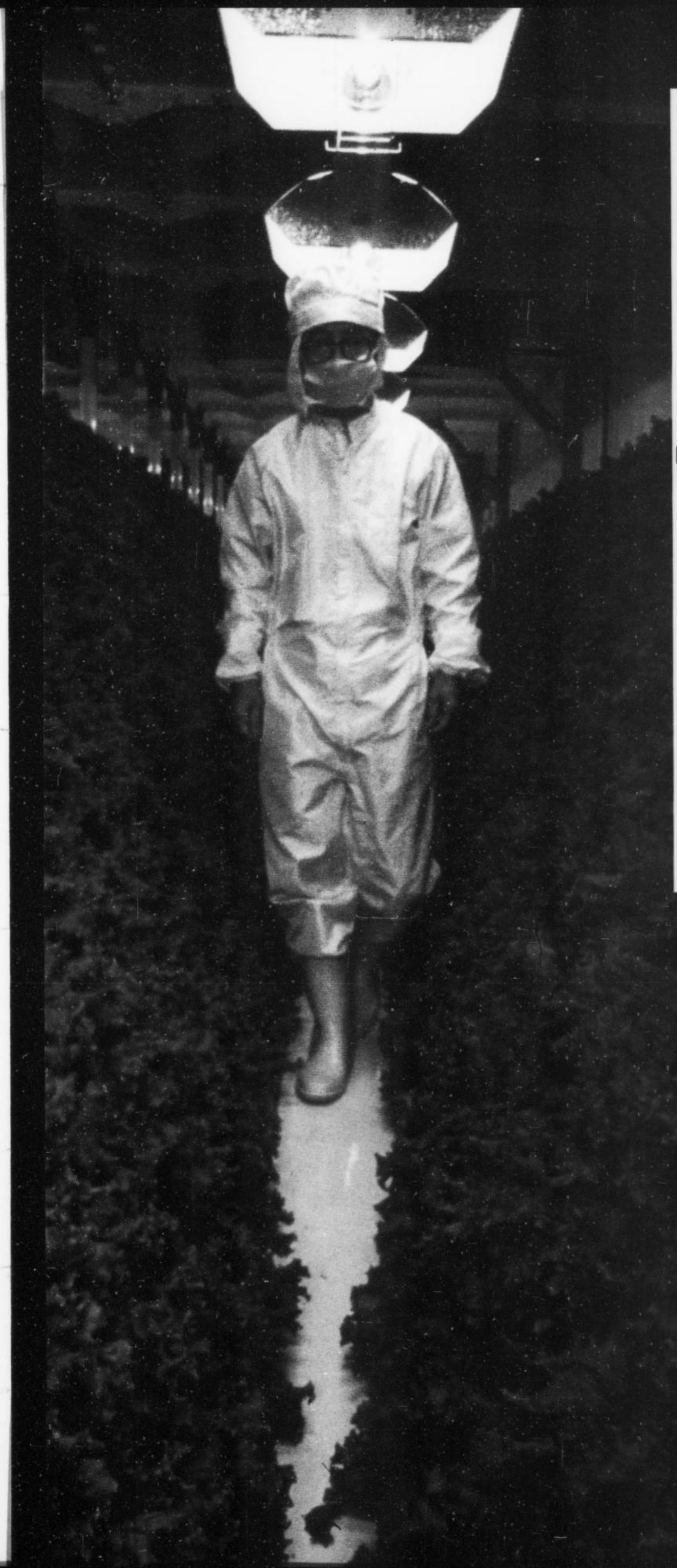
—I don't know it well. I ought not to say that, because one cannot know flamenco, one can only feel it. It hasn't often happened to me, but whenever I have had an opportunity to see and hear great *cantes* being interpreted, I have been extremely moved.

■ *Literature uses words, music uses sounds. Architecture, sculpture and painting deal in matter. Does this mean that there are uncrossable frontiers between these different forms of expression?*

—Speaking from experience I will say no. These are academic classifications that are used by force of habit. Sometimes I feel that I am very close to the poets: it has even been said that some of my paintings are poetic metaphors. At other times I feel affinities with music: I use fragile materials which when they crack produce a musical sound. I have also been told that my relief effects in painting are close to sculpture, and in fact I deliberately work in three dimensions. Today the very precise frontiers that separated painting, sculpture and other forms of art are tending to fade away.

■ *You designed the medal struck by UNESCO to commemorate the centenary of the birth of Pablo Picasso. And you recently designed another to mark the centenary of the birth of Joán Miró.*

—When UNESCO entrusted me with these commissions, I felt a tremendous sense of satisfaction since it created a kind of continuity, a link with the preceding generation through Picasso and above all Miró whom I knew very well and to whose work I have devoted much study. I even worked with him since I was a member of the governing body of the Miró Foundation in Barcelona. I feel very close to him and I have always had great admiration for him both as a man and as an artist. He was extremely human and had a vision of the world that was full of fantasy. We both tend to escape into dreams, dreams that are rooted in the depths of our being and awaken in the unconscious mechanisms that are far closer to tangible reality and everyday life than one might think. I see in Miró's painting the convulsions of the break with academicism and the return to innocent things charged with meaning. As for Picasso, with the generous positions he took, his fidelity to humanism, and his espousal of certain critical approaches to social and political issues, he was for me a great master. ■



BIO TECHNOLOGY

THE RESOURCEFUL GENE

✔

By unlocking the treasury of the living world, modern biotechnology can help to solve some of the world's most urgent problems — hunger and malnutrition, disease, energy supplies and pollution....

BIOTECHNOLOGY FOR BEGINNERS

by Monkombu Sambasivan Swaminathan

Previous page, lettuce grown in liquid nutrients, using the technique known as hydroponics, in a Japanese vegetable factory. Kept at constant temperature with 24-hour-a-day lighting in a carbon-dioxide-rich atmosphere, the lettuce reach maturity 4 to 5 times faster than normal.

AMONG the more than five billion women, men and children living on our planet, no two individuals are alike and the same is true of cross-pollinated plants as well as animals and micro-organisms. This kaleidoscopic diversity, which exists in all living beings, provides the basis for biotechnology, which may be described as the technological modification and improvement of living organisms.

The rediscovery of Gregor Johann Mendel's laws of heredity in the early part of this century helped promote an understanding of the origins and workings of genetic diversity. The principal phenomena involved are segregation, mutation and recombination of genes. Together, these three actions generate opportunities for the immense genetic diversity in living organisms.

In the past, the existence of genetic variability enabled humans to select plants and animals for domestication. Over 10,000 years ago, plants such as wheat, barley and rice were selected for cultivation from the wild flora. After their initial domestication, these crops were continuously improved through selection of naturally occurring variability. In plants like fruit trees and the potato, occasional mutations gave rise to new varieties. Thus, today, we not only have over 1.5 million species of plants and animals, but also a large number of genetic strains within species. For example, more than 100,000 varieties of rice are grown in different parts of the world.

From the beginning of this century, techniques such as planned hybridization and later, the induction of mutations, were used by agricultural and biological research institutions to create new genetic combinations. Hybridization also became a method of increasing the growth of crops and animals, a phenomenon known as hybrid vigour. Hybrid maize developed in the United States in the 1930s helped to double maize yields. The identification of genes for a semi-dwarf plant type in wheat in Japan and in rice in China in the 1940s provided the raw material for the green revolution witnessed in these crops in Asia in the late 1960s. Identification and utilization of genetic mechanisms for male sterility in plants made the commercial exploitation of hybrid vigour possible even in a self-pollinated crop like rice. Today, hybrid rice occupies nearly 18 million hectares in China.

Biological diversity thus became the basis of continuous improvements in productivity. Selection, mutation and hybridization were used to improve plants, animals and micro-organisms of interest to agriculture, industry and medicine. Thus, new antibiotics and vaccines could be developed. Fermentation technology made rapid strides. Classical biotechnology involving non-molecular techniques is responsible for many of the improvements witnessed in scientific endeavours involving living organisms.

Genetic engineering—the hard core of modern biotechnology

Against this background, we may examine the new vistas opened up by molecular biology. This area of science was inaugurated by James Dewey Watson and Francis Crick forty years ago when they described the double helix structure of the deoxyribonucleic acid molecule, commonly known as DNA. Since then, emphasis has shifted to the study of the molecular basis of genetic diversity and to the standardization of methods that can help achieve novel genetic combinations through what are known as recombinant DNA techniques, whereby scientists use tiny circular pieces of DNA known as plasmid vectors to achieve gene splicing. These techniques have opened up a new world of genetic engineering, leading to the creation of transgenic organisms—organisms containing genetic material into which DNA from an unrelated organism has been artificially placed. They are already being used in the production of insulin, interferon, and human growth hormone. Although the term "biotechnology" is used to denote a wide range of procedures such as cell and tissue culture, micro-propagation and fermentation, the hard core of modern biotechnology is genetic engineering.

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Biogas production on a farm in the village of Rangasamudra, Karnataka province (India). Cow dung is mixed with water in a trough from which it is piped into a tank where it is transformed by heat into natural gas (photos 1 and 2). As a result of this easy-to-use system, gas can replace wood as domestic fuel (photo 3), thus helping to halt deforestation in this part of southern India.

The birth of an industry

Present-day biotechnology, which combines conventional and molecular techniques, has every prospect of becoming a great industry. In addition to already existing applications in health and medicine, large-scale uses in agriculture, industry, energy supplies, environmental protection and the exploration of space are becoming exciting possibilities. Biotechnology will probably provide the key to producing more food and other agricultural commodities from less land and water in the twenty-first century without the adverse ecological implications associated with the high doses of mineral fertilizers and chemical pesticides being used now to make high-yielding varieties of rice, wheat, maize and other crops express their full potential.

Many transgenic plants are currently under field testing in several parts of the world. Early applications of recombinant DNA methodology gave rise to micro-organisms that can clean up oil spills. This led to the birth of bioremediation technology, which has been widely used to treat the problems of "oil lakes" created by the 1991 Gulf War. In fact, biotechnologies have opened up unlimited opportunities for the purposeful use of biological diversity. For example, at our Research Centre in Madras, we are assembling a gene pool for

In the United States tomatoes with a shelf-life of several weeks are grown by deactivating the enzymes that cause them to rot. In container at left are ordinary tomatoes 25 days after being picked; at right, genetically altered tomatoes.

Drought-resistant crop varieties and a new system of drip irrigation enable farmers to grow asparagus in the desert of Ica (Peru).

breeding crops for tolerance to salt-water intrusion. Mangrove trees that inhabit intertidal regions along the shore have such genetic traits. When we have enough scientific knowledge, it may be possible to transfer genes for salt-water tolerance from mangrove trees to other plants. Such research is important due to the possible rise of the world's sea level in the not-so-distant future.

Microbiological enrichment of cellulosic wastes can be an important source of animal feed, particularly where farm animals are reared under stall-fed conditions. Biomass refineries are now being established in several countries.

Questions of safety and ethics

New research tools always generate hope and fear, and questions about safety and ethics have kindled public concern about biotechnology. Critics fear that "playing God" with living systems may create an environmental or medical disaster, or lead us to interfere with human nature itself. This is why countries with a significant biotechnology programme also have strict biosafety regulations. Committees dealing with ethical issues also exist in many scientific organizations.

Another issue of public concern, particularly in developing countries, is the use of basic genetic material from plants from these countries by private seed companies in industrialized nations solely for private profit. Since most biotechnological research in industrialized nations is in the private sector, and the private sector depends on developing countries for genetic resources, questions relating to systems for patenting and monetary compensation are the centre of widespread international attention. This was reflected in the Global Biodiversity convention signed by over 150 nations at Rio de Janeiro in June 1992.

Besides providing the foundation for global food security and for sustainable livelihoods, the wise use of biotechnology and a broader understanding of both conventional and molecular genetics could contribute to the elimination of irrational beliefs and prejudices about the dangers of diversity. These societal benefits may ultimately be the most significant contributions of modern biotechnology. ■

MONKOMBU SAMBASIVAN SWAMINATHAN is an Indian scientist who played a leading role in the "Green Revolution" in Asia. He is Director-General of the International Rice Research Institute, Los Baños, The Philippines, and has worked extensively in the fields of plant genetics and agronomic research and development.

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ACHIEVEMENTS, EXPECTATIONS AND CHALLENGES

by Albert Sasson and Edgar J. DaSilva

Advances in biotechnology are transforming social and economic structures

THE world of biotechnology is vast and varied. Some idea of just how varied can be gauged from a report published by the Organization for Economic Co-operation and Development (OECD), which defined biotechnology as "the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services". The "biological agents" referred to are mainly micro-organisms, animal and plant cells, and enzymes. The "goods and services" include the products of the agriculture, fishery, food processing and pharmaceutical industries.

The scientific basis of biotechnology is multidisciplinary, and the core disciplines include molecular and cell biology, biochemistry, genetics, microbiology, immunology, chemical and process engineering, computing and data processing. So many fields of activity are involved that it is perhaps more appropriate to talk of "biotechnologies" in the plural rather than the singular. These technologies may be simple or sophisticated, cheap or expensive. They range from time-honoured processes such as fermentation, to genetic engineering, the ability to take hereditary characters from one organism and transplant them into another, thus creating "transgenic" plants and animals with desired characteristics.

Genetic engineering is a powerful tool that holds vast promise for medicine and agriculture, where basic research has advanced so far since the mid-1970s that there has been much talk of a "biotechnological revolution". However, it raises many sensitive ethical and legal questions, as well as questions relating to safety and public attitudes.

During the 1980s, biotechnologies in the industrialized countries progressed on many fronts. In North America, research led to the discovery and manufacture of the first commer-

Monoculture — the cultivation of large tracts of land to produce a single variety of crop which is harvested all at once — is a typical feature of modern large-scale agriculture. It has a number of disadvantages including low resistance to pests, the use of large amounts of chemical fertilizers and pesticides, and consequent risks of groundwater pollution. Below, a wheat field in Canada.

These scientists at the Botanical Conservatory at Porquerolles (France) have propagated *in vitro* date palm plantlets resistant to "Bayoud", an incurable disease which threatens the palm groves of North Africa and, eventually, elsewhere.

cial biotechnology-derived products such as insulin, human growth hormone and tissue plasminogen activator. The most recent such product was the antihaemophiliac factor VIII, produced by an American firm for the treatment of haemophilia A. Also in pharmaceutics, new developments in molecular biology made it possible to produce vaccines using yeasts and animal cells. Attempts were made to increase the rate of growth of farm animals by injecting growth hormones produced via genetic engineering. So far there are no transgenic animals on the market, but transgenic animals such as mice are being used in the laboratory as human disease models. Some of these recent and possible future developments are shown in the box on page 14 and others are described elsewhere in this issue.

However, a "knowledge revolution" does not necessarily lead immediately to a revolution in practice. It has, for example, been estimated that it may take twenty or thirty years before the impact of recent biotechnological discoveries in plant and animal breeding and in food production is truly felt.

Consumer interests and biosafety

In the public mind biotechnologies are often identified exclusively with genetic engineering or with human reproduction technologies rather than with industrial microbiology, biochemical engineering or fermentation, or associated with food safety or public health concerns.

Governments and industry are increasingly aware that there is a need to inform the public better about the new biotechnologies, that the participation of both experts and non-specialists is required to assess the objectivity of information, and that public confidence in regulation effectiveness must be significantly improved.

France is one European country that has established a mechanism, in the form of a Committee on Biomolecular Engineering, to control the risks associated with the production and release of genetically-engineered crop species or domestic animals. According to the Committee, 1993-1994 would be a crucial period when numerous projects concerning transgenic plants implemented over several years were close to the homologation phase prior to marketing. Most of the requests for trials examined by the Committee concerned plants that had been engineered for resistance to herbicides, insect pests or specific diseases, or were designed to provide improved nutritious quality. A similar situation existed in other industrialized countries.

In the United States, the government was asked by the Environmental Defence Fund and several other groups to create new, or modify existing, regulatory structures for biotechnologies through legislation. However, the U.S. government's "Report on National Biotechnology Policy" found that the risks posed by bio-engineered organisms should not be exaggerated and stated that "products developed through biotechnology do not *per se* pose risks to human health and the environment." On 26 May 1992, the U.S. administration announced that genetically modified foodstuffs would not need special authorization or labels before being marketed, because they do not pose specific biosafety problems. This decision, which was criticized by several consumer and environmentalist groups, ended a ten-year period of uncertainty for the industrialists concerning the regulations on the use of biotechnologies in the agro-food sector.

Economic effects

Biotechnologies are expected to make a significant impact on agricultural production. Market balances published for the United States and Europe suggest that they could increase productivity by decreasing costs per unit of output (e.g. fewer chemical inputs) or by increasing yields per unit of output. Forecasts made in the early 1990s mentioned possible milk production increases of from 10 per cent to 16 per cent within a five-to-ten-year period, if bovine growth hormone were to be used. (Its utilization was approved by the Food and Drug Administration in November 1993.)

Biotechologies are expected to contribute to long-term trends towards the reduction of the share of agriculture in total employment, but job loss may be partly offset by job creation in related sectors, particularly the food-related services. Still, the dissemination of agricultural and food technologies in the OECD countries is expected to be a gradual process in the next decade, without major, destabilizing impacts on the social structure of employment.

During the 1980s biotechnologies were established in developing countries with varying degrees of priority and sophistication, a process illustrating not only the contrasting economic

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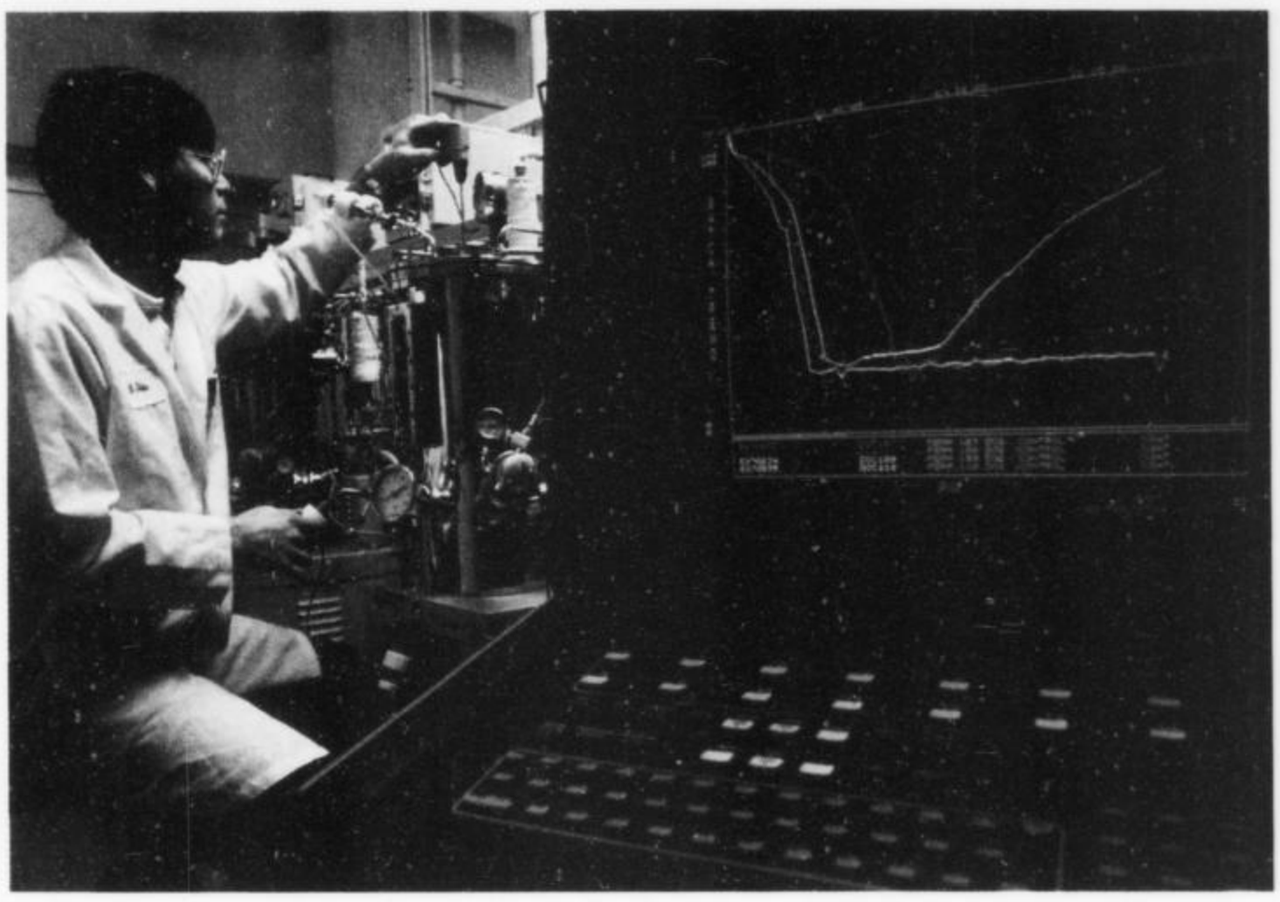


A biochemical engineer in the United States carries out a computer-controlled process for the development of a malaria vaccine using genetic engineering.

and scientific development conditions of these countries, but also the various possibilities for applying biotechnologies at levels of investment and complexity suitable for each specific situation.

Biotechnologies and developing countries

Everyone agrees that developing countries need to move up the gradient of biotechnologies, from the low-cost ones to the more sophisticated and expensive ones. The more richly endowed national systems are already well on the way, and even the smallest and poorest need to think about developing and using modern biotechnologies. For instance, a country where crop species provide the staple food could profitably invest in a tissue culture laboratory, at a capital cost of about $20,000. This would enable it to import, as tissue cultures, virus- or disease-free clones developed in research stations abroad, and to multiply them rapidly, if they proved adaptable to local conditions and acceptable to producers and consumers.

The significance of biotechnologies for the Third World is illustrated by the example of Asian agriculture. In the early 1990s, Asia has more than 50 per cent of the global population, over 70 per cent of the world's farming families, but only 25 per cent of the world's arable land. At the beginning of the twenty-first century, the per capita land availability may be 0.1 hectare in China and 0.14 hectare in India. Meanwhile, the average Asian population growth rate is 1.86 per cent. The only way for countries like China and India to feed their growing populations is through continuous improvement in yields. China has gone into large-scale exploitation of rice hybrids for this purpose.

There has been an almost three-fold expansion in the world's irrigated land since 1950, much of it in the developing countries. Scope for further expansion is being gradually reduced and consequently improved water management and the incorporation of genes for drought tolerance into major crop species are now urgent necessities.

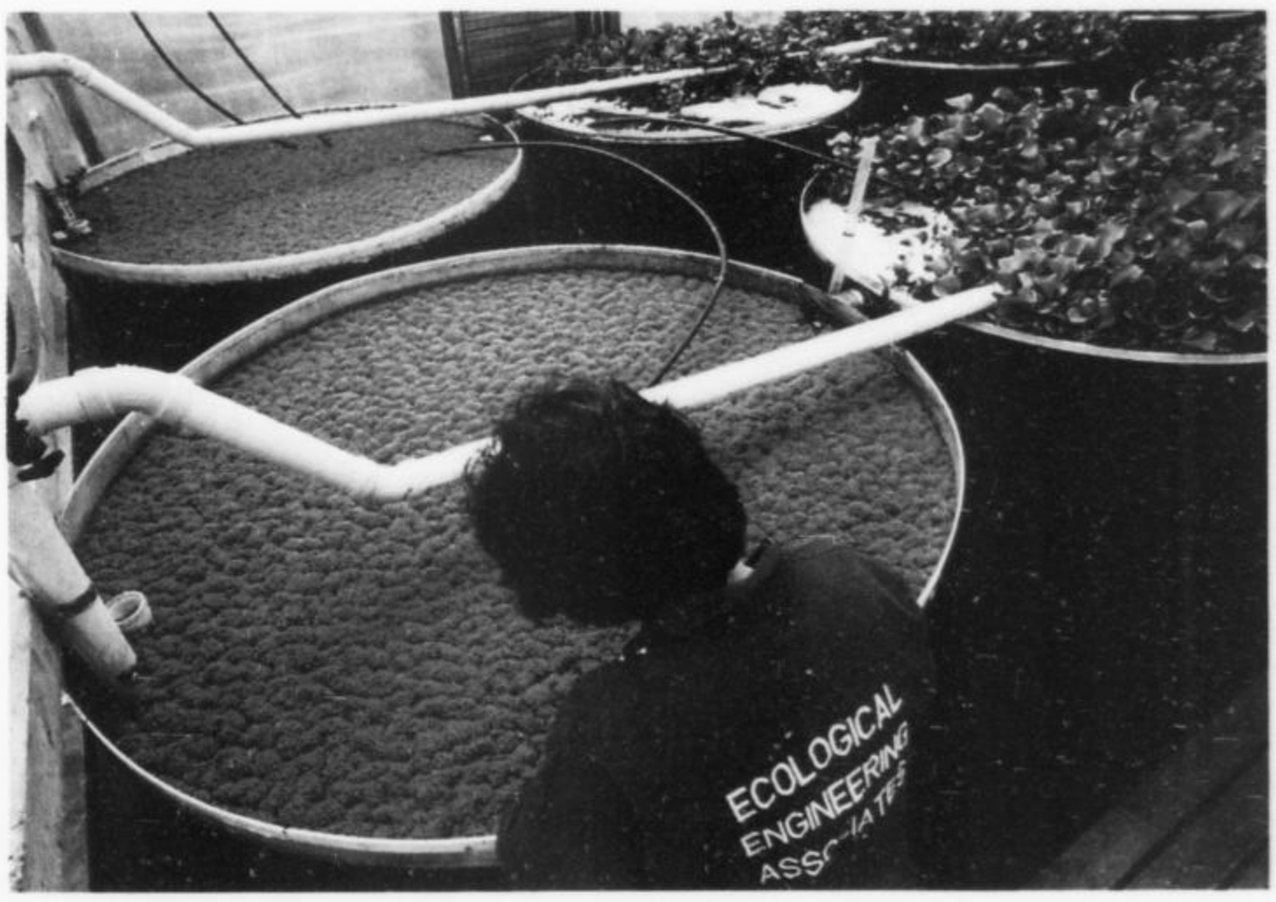
As we have seen, however, more than excellent research is needed before biotechnologies can achieve commercial success. The latter depends on factors related to "social capability", which includes facilities for the diffusion of knowledge and conditions facilitating structural change. Today scientists and political leaders in developing countries are concerned about a number of aspects of current global trends in biotechnological research and development. Some of the questions they are asking themselves are:

☞ Will the "biotechnology revolution" help resource-poor farmers increase productivity?

☞ Will genetic engineering research directed at finding substitutes for national products not have adverse impacts on the farming sector and the export products of their countries? Such fears are based, for example, on the possible use of natural or synthetic sweeteners as substitutes for cane or beet sugar, as well as the development of substitutes for vanilla flavouring, cocoa butter and diosgenin.

☞ Will products produced by genetic engineering be safe? Will developing countries be used as testing grounds for genetically modified organisms, as a way of avoiding the stringent regulations prevailing in the industrialized countries?

☞ What will be the impact of the extension of intellectual property rights to individual genes and genotypes on the availability of such improved material to developing countries and resource-poor farmers? Will intellectual property rights be exclusively reserved for rewarding formal innovation, even though the informal innovation system has played, and is playing, a key role in the identification and conservation of plant and animal and genetic resources?



In this water purification facility at Narragansett, Rhode Island (U.S.A.), waste water is purified naturally though processing in tanks by minerals, bacteria, fungi and algae (foreground), and then by certain species of molluscs, fish and large aquatic plants (background).

THE STATE OF THE ART

The 1980s and early 1990s have seen rapid advances in biotechnologies on many fronts. Here is a sample of achievements and prospects:

PHARMACEUTICALS

Today . . . **production by microbial or animal cells of hormones, substances for breaking down blood clots, blood coagulants, lymphokins, interferons (anti-cancer), vaccines against viral, bacterial and parasitic diseases (e.g. hepatitis B and C, schistosomiasis, malaria)**

and tomorrow. . . **Breakthroughs may occur in the fields of anti-Aids vaccines or drugs and anti-cancer medicines.**

DISEASE-RESISTANT PLANTS

Today. . . **Progress has been rapid since 1982, when the first transgenic plant was created. Several dozen plants have since been modified to increase growth performance and resistance to viruses and other pathogens. In 1994, several hundred trials were being carried out on transgenic plants in Europe, North America, Japan and Australia.**

and tomorrow. . . **Some of the transgenic plants already tested (potato, cotton, rapeseed, tomato, tobacco, soybean) are expected to be marketed by the mid- or late 1990s. A transgenic tomato variety with a prolonged shelf-life (U.S.A.) is already being marketed; this will also be the case for a virus-resistant tomato variety (Japan). However, delays due to safety requirements, public concern and the need for more research may slow down large-scale marketing of genetically modified crop species between now and the year 2000.**

NEW FOODS

Today. . . **Bioconversion of starch into sweet products, food flavours and enhancers, fruit-juice processing; derivation of amino-acids and other nutrients, pigments and vitamins from micro-algae; new foods from fermentation; cheese-making enzymes, lactose-free dairy products, yeast hybrids.**

and tomorrow. . . **Products that may be marketed by 1995 include genetically modified baker's yeast, new food colourings and ingredients, high added-value compounds from plant cell and micro-algal cultures. By the end of the century we may see genetically modified food bacteria for flavour and quality, modified food enzymes, novel biocatalysts for food processing, and increasing numbers of rapid biotests and biosensors for food contaminants or pathogens.**

FASTER-GROWING ANIMALS

Today. . . **Already in commercial exploitation are: diagnostics, new vaccines and drugs, *in-vitro* fertilization and embryo transfer in domestic animals, growth hormone administration to increase growth and milk yield, feeds and feed additives. So far no transgenic domestic animals are on the market. Transgenic animals such as a transgenic mouse carrying a human cancer gene have been used in the laboratory as human disease models.**

and tomorrow. . . **Between now and the end of the century, the development of fish, pigs and cattle with rapid growth potential through the insertion of growth hormone genes, improved carcass quality and, for cattle, increased milk yield, is expected to be rapid. Gene transfer may also lead to the multiplication of genetically superior animals through the development of disease-resistant breeds.**

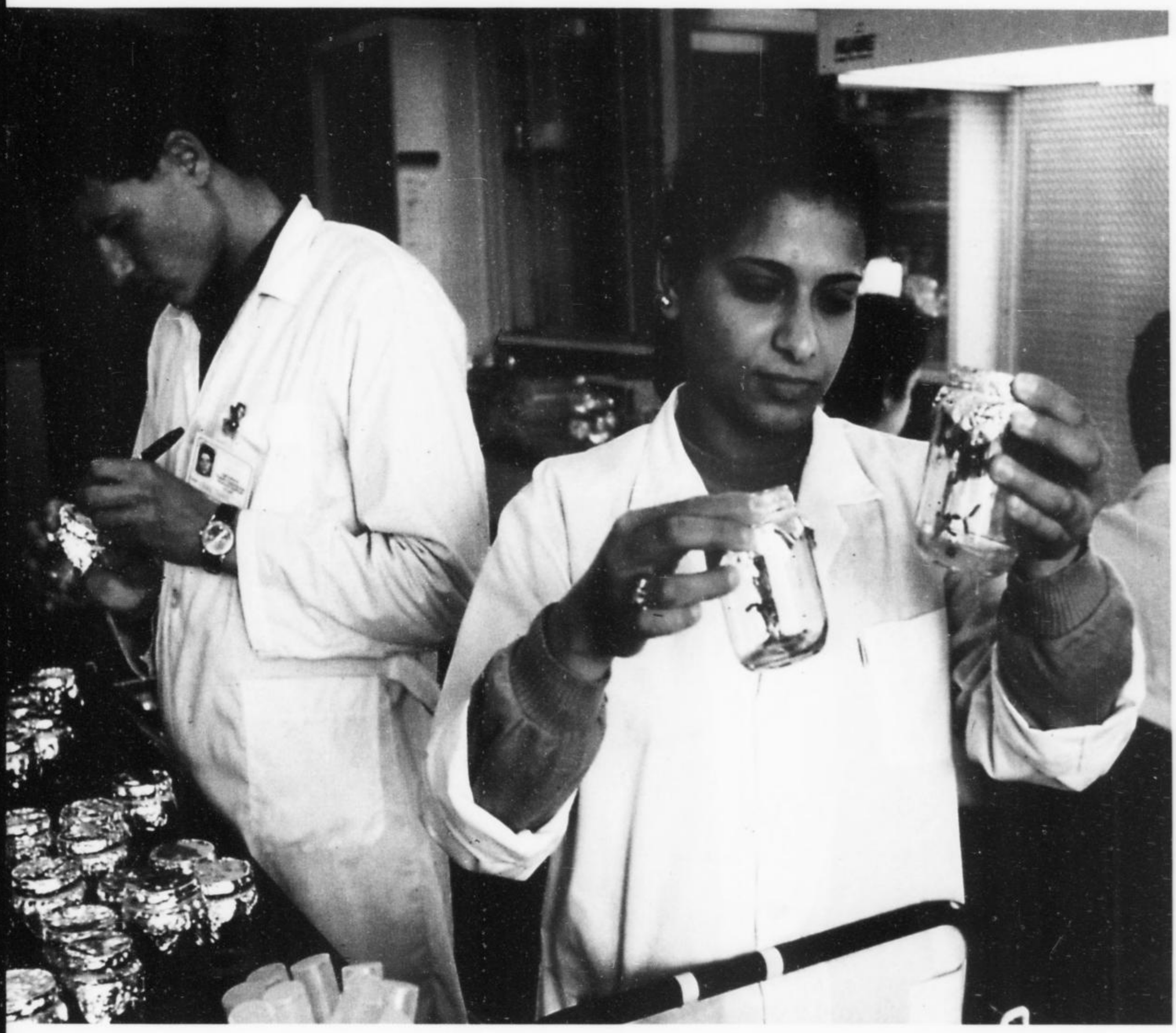
MORE PRODUCTIVE FISH AND ALGAE

Today. . . **Growth hormone genes from rainbow trout have been inserted into a number of other commercial fish species. No transgenic fish have yet been patented. A wide range of products derived from micro-algae are used in the manufacture of foodstuffs, cosmetics, dyes, paints, paper, textiles, etc.**

and tomorrow. . . **Vaccines for disease and stress control in aquaculture is a probable growth area. In Scandinavia nearly all trout and salmon produced by aquaculture are vaccinated, compared to 5% ten years ago. Promising new antibiotics, anti-cancer agents and food additives will be developed.**

T. Yoshida

TOSHIOMI YOSHIDA, of Japan, is a Professor at the International Centre of Co-operative Research in Biotechnology, Faculty of Engineering, Osaka University.



A cell culture laboratory in Egypt.

☞ Will it be possible to balance the market-driven features of biotechnology research by concern for the long-term well-being of humankind, poor as well as rich? Research on staple food crop species in the developing countries needs to be supported internationally, for the sake of global, human sustainable development conducted in a spirit of solidarity. The same international effort is required to find cures for diseases prevailing in the Third World.

No panacea

The perfecting of conventional biotechnologies and the expansion of more advanced biotechnologies as a result of further discoveries in cell and molecular biology are leading to far-reaching economic and social change because of their applications in agriculture and food production, the cure and prevention of disease, the meeting of energy needs, and environmental protection. The spectacular progress of biotechnologies is full of promise for humankind.

However, these advances should not be seen as a panacea. They are not intended to substitute, but to complement, the wide range of technologies used in the various areas of social and economic development. For instance, plant biotechnologies, including genetic transformation of crop species and varieties, are complementary to conventional crop breeding and selection of cultivars.

The value of biotechnologies is that they can be applied at different levels of complexity, investment and effort in the production of food crops, livestock husbandry, chemical and pharmaceutical industries, the conversion of biomass into fuel, the transformation of agricultural and industrial by-products and pollution abatement. Developing countries are now taking advantage of these characteristics. This trend will continue. ■

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THE MAGIC OF MUSHROOMS

by P. Atthasampunna and S. T. Chang

Fungus with a future

THE mushroom has always been a thing of mystery. In ancient times the seemingly miraculous manner of its growth without seed, its sudden appearance after rain, its equally rapid disappearance and its curious umbrella-like shape gave rise to a wealth of allusions and mythologies. Today, it is continuing to perform feats of magic and versatility, not only as a source of food, but by helping to convert agricultural and industrial wastes into useful matter.

The mushroom as symbol of longevity. Detail of a Korean painting (late-18th, early-19th century).

Edible mushrooms provide high quality protein that can be produced with greater biological efficiency than animal protein. They are rich in fibre, minerals and vitamins, and have a low crude fat content. These properties are major contributing factors to the traditional recognition of mushrooms as "healthy" food.

However, although a large number of mushroom species are not only edible but also possess tonic and medicinal qualities, some are lethally poisonous. There is no simple way of distinguishing between edible and poisonous mushrooms, and one should eat mushrooms only if one knows their names and their properties with considerable precision.

Mushroom cultivation, moreover, requires relatively little in terms of large-scale equipment, capital, land and processing. In the rural areas of less-developed countries, where large-scale capital-intensive operations are inappropriate, well-managed mushroom farms can make important contributions to the nutrition and economic welfare of the local people. This is especially true in regions where the indigenous population suffers from protein deficiency.

Nature's garbage man

However, the mushroom would not be worthy of its versatile reputation if it were only a source of food. It can also help to solve one of humankind's most urgent and growing problems—its propensity to create waste.

Above, *Shiii take (Lentinus edodes)*, a fragrant mushroom grown in Japan from which a natural product, active against certain types of tumour, is extracted.

Below left, the poisonous mushroom fly agaric *(Amanita muscaria)*.

The agricultural, forestry and food processing industries generate huge quantities of wastes, much of which is either burnt, discharged into watercourses or used for landfill. And yet it constitutes a potentially valuable resource. Most agricultural, industrial and household solid wastes are rich in organic matter, mainly cellulose, hemicellulose and lignin, substances that are highly resistant to biological degradation and have little or no food value in their original form. Furthermore, their disposal can be a major source of environmental pollution. However, when properly treated with bioconversion technology—the process whereby micro-organisms are used to transform organic residues into utility products—they can be modified and upgraded into high-quality protein for human and animal consumption, and used for the production of microbial metabolites and the generation of new feedstocks for the polymer industry, which creates materials such as plastics, resins and synthetic rubbers.

Edible mushroom production is a particularly effective form of bioconversion technology. Mushrooms differ from green plants in that they cannot use sunlight to manufacture their food. What they do is produce enzymes that degrade the complex substrates on which they grow and then feed themselves on the soluble substances thus produced. They can be cultivated on a wide variety of woody and cellulose wastes, and the spent residue left after harvesting can be used as an animal feedstock and/or a soil conditioner.

There is also rapidly growing interest in

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S.T. CHANG, of Australia, is a specialist in fungal genetics. A former Executive Secretary of the Headquarters of UNESCO's Southeast Asian Network on Microbiology, he is now Chairman of the Biology Department at the Chinese University of Hong Kong and Director of the Hong Kong MIRCEN on Bioconversion Technology. He is a member at large of the Executive Board of the International Union of Microbiological Societies.

Mushroom spore used to inoculate wood with fungus for growing *Shii take* on a mushroom "farm" in Texas (U.S.A.).

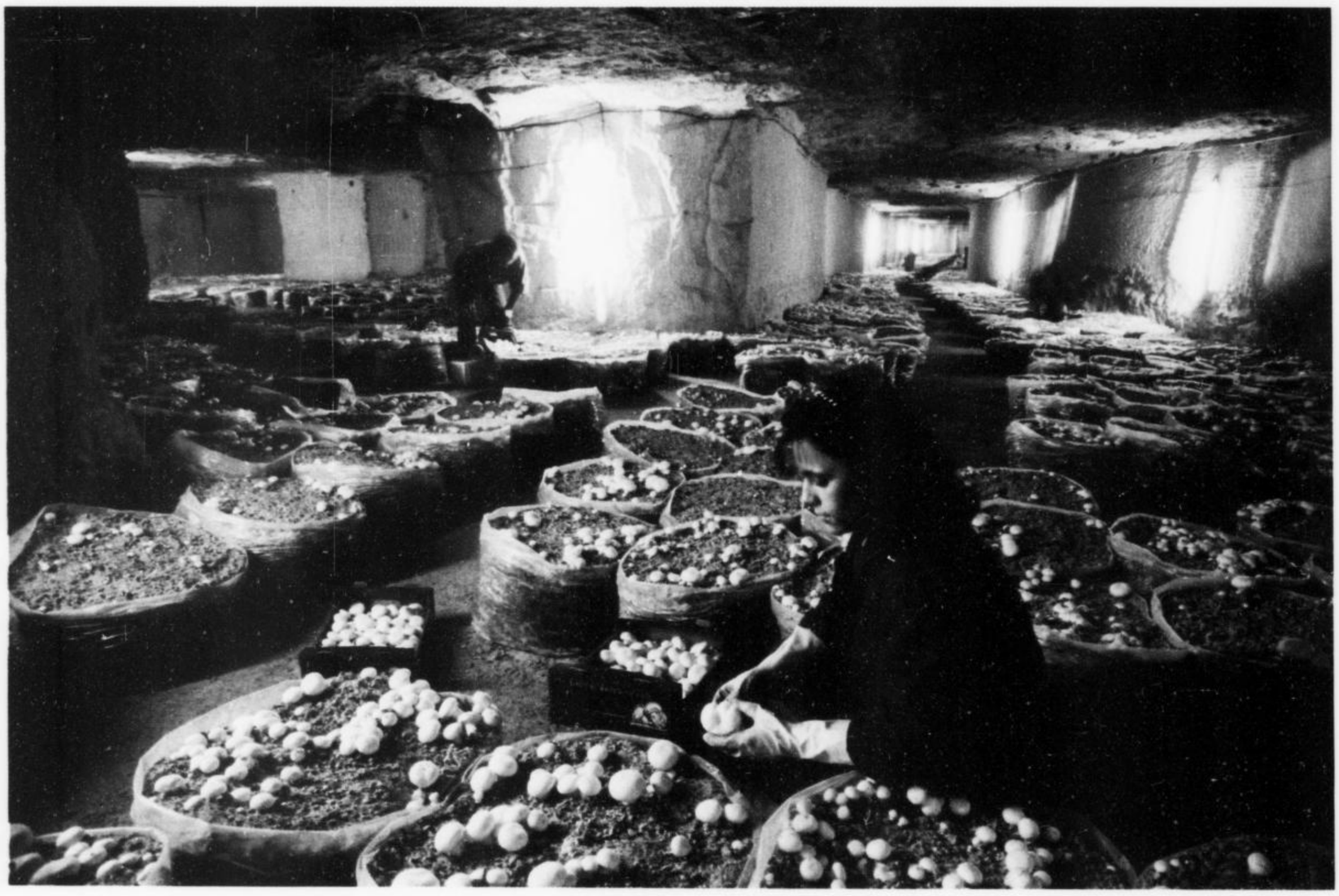
mushrooms as a source of high-value metabolites, substances which can be used to treat tumours, strengthen the immune system and reduce blood pressure and cholesterol levels. One such substance, PSK, also known as Krestin, is made from the mushroom *Coriolus versicolor* and has become the best-selling anti-cancer drug in Japan, where it has 25 per cent of market share and in 1987 had an annual sale of $357 million. One Japanese company has annual sales of lentinan, a polysaccharide derived from another mushroom, *Lentinus edodes*, amounting to $90 million. These natural products are active against certain types of tumours and have the advantage of not being toxic to non-target cells.

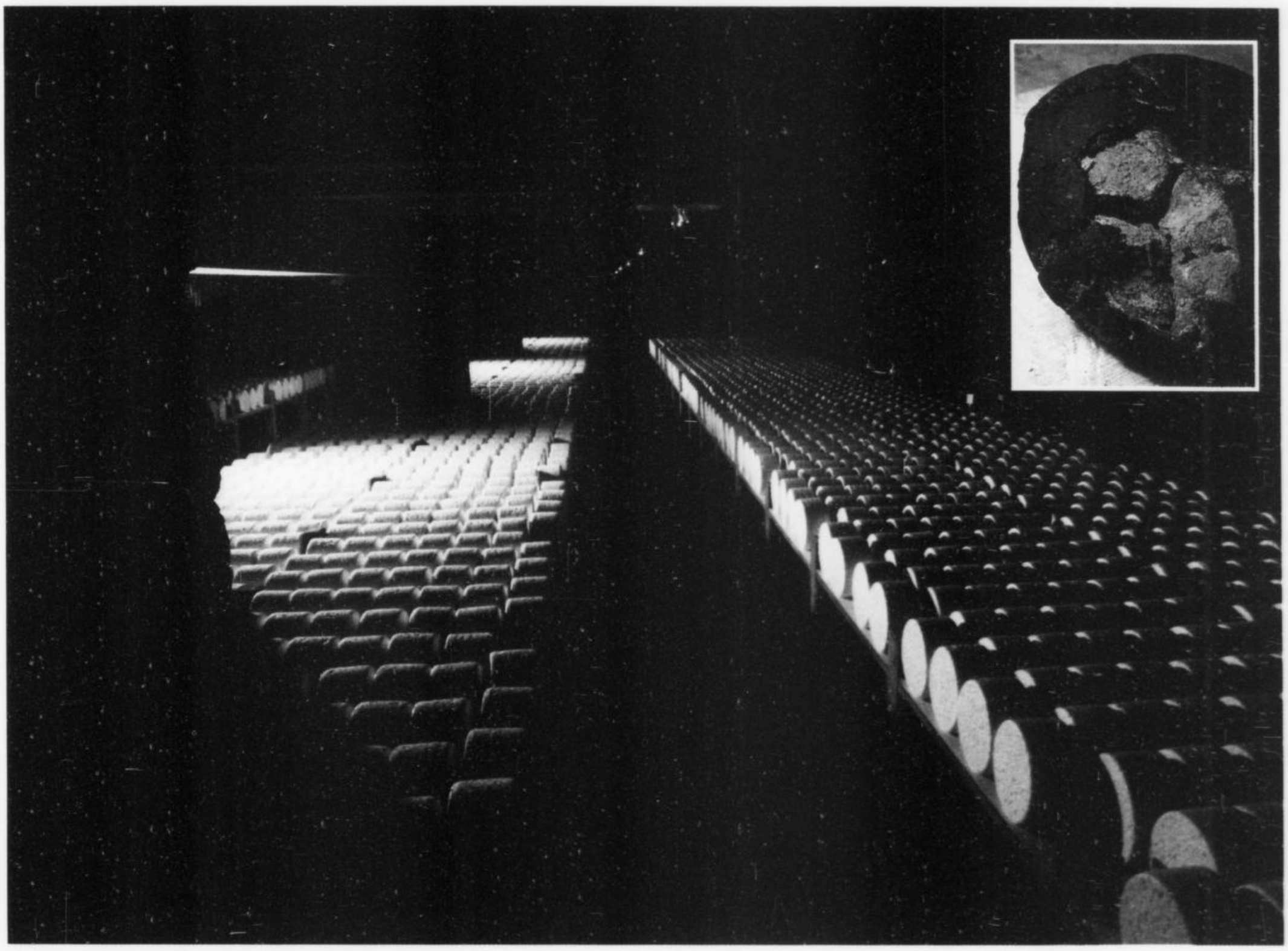
Mushrooms also represent a relatively untapped source of novel products for use in the food and drink industries as illustrated by the growing number of products reaching the retail market. Important examples include natural food additives such as colorants and flavour compounds that can be used to replace chemical additives that are often considered less acceptable. Furthermore, the food industry is already subject to consumer pressure to produce "healthy" foods and, as the emphasis on prevention rather than cure of diet-related diseases grows, this trend will become even stronger.

It should be noted that world production of cultivated edible mushrooms is, well, mushrooming. Nearly 4,000 tons of mushrooms were cultivated worldwide in 1989-1990, a dramatic increase from just over 2,000 tons cultivated in 1986. There has been a particularly sharp increase in growth over the last five years. This trend is expected to continue in the future.

While it is likely that more low-tech processes such as mushroom bioconversion technology will be of interest to developing countries, it is certain that the application of microbial biotechnology to solid organic wastes will be an important tool for their food industries and environmental management in the years to come. ■

Cultivated mushrooms are grown in former quarries near Paris on sacks of manure covered with crushed chalky soil. The harvest lasts from 3 to 6 months.





CREATIVE FERMENT

by Peter L. Rogers

Known since Antiquity, fermentation processes offer great opportunities to today's food industry

FERMENTED foods and beverages, in their many and varied forms, have been a great source of pleasure to humans over the centuries. The ancient art of cheese-making involves the fermentation of milk or cream. Bread involves a yeast fermentation, and loaves of bread have been found in Egyptian pyramids built 6,000 years ago. The discovery of fruit fermentation was made so long ago that the ancient Greeks believed that wine had been invented by one of their gods, Dionysus. And from about 2500 B.C., Egyptian documents describe the malting of barley and the fermentation of beer. *Kui*, a Chinese rice beer, has been traced back to 2300 B.C. More than 3,000 years ago, the Chinese used mouldy soybean curd to clear up skin infections and Indians living in central America used fungi to treat infected wounds. The *Penicillium* mould in cheese-making was often used for similar purposes.

It is only since the time of Louis Pasteur, who in 1857 established that alcoholic fermentations were caused by living cells, that we have begun to understand the fundamental role of micro-organisms in these fermentation processes. In fact, the successful development of the food industry in Western countries has involved the use of micro-organisms not only to enhance the flavour, texture and nutritional qualities of many foods and beverages, but also to control spoilage through sterilization and proper packaging. In other societies as well, control of spoilage has been achieved by fermentation.

In recent times, there has been a growing interest

Above, rows of ewe's milk cheeses in a cave at Roquefort-sur-Soulzon in the Aveyron department of France. Bread-mould (inset) is added to the cheeses as they ripen.

in studying traditional food fermentations with a view to understanding the characteristics of the micro-organisms and to designing better processes for foods with enhanced flavours and better nutritional and preservative qualities.

A recipe for flavoursome fish sauce

Fermented foods can be classified broadly into three types, depending on the way the fermentation is carried out. Some fermentations occur under liquid culture conditions, some take place almost entirely on solid material, while others are a combination of both. Some of these processes are now being practised on a very large industrial scale, but it is important to remember that most, if not all, had their origins in traditional small-scale activities.

In liquid culture fermentations, the raw materials for the fermentation are allowed to solubilize or are mixed together with large quantities of water. Then either a specific inoculum is added to start a new culture, or a natural culture develops. A good example is the production of fish sauce, which has been practised widely in Korea, Japan and other Asian countries for centuries. Because fish are highly proteinaceous, they spoil very rapidly in tropical temperatures. To make fish sauce, the fish is normally mixed with salt (20-35 per cent) and allowed to solubilize in vats or tanks at tropical ambient temperatures.

The maturation process, which involves the transformation of the fish tissue into simpler compounds (by the action of enzymes) and the subsequent growth of beneficial microbial flora (which suppresses harmful micro-organisms) usually takes three to twelve months or longer. During this period special bacteria and yeasts, which are capable of surviving the higher salt concentrations, develop and give the final fish sauce its distinctive flavour and aroma. Other examples of liquid culture fermentations are fermented milk products such as yoghurt and soy sauce. (Soy sauce production was described in seventh-century Chinese and Japanese literature and more than one million kilolitres of it are produced annually in Japan today.)

Semi-solid fermentations are usually carried out with solids such as grains or chopped vegetables that are mixed with water and allowed to ferment. The production of *ogi*, a traditional African fermented starch cake made from maize, sorghum or millet grains, is a good example of a semi-solid process. Fermentation is anaerobic and spontaneous, and requires only one or two days. During this time, the *ogi* develops a yoghurt-type flavour which is a critical factor in its acceptability. Various moulds and bacteria have been identified during the fermentation process and it is evident that *Lactobacillus* bacteria are responsible for the production of lactic acid, which is the major component of

In Abomey (Benin), a girl sells *yovo-doko*, a fritter made of *marwè*, a fermented paste of sugar, yeast, wheat and maize flour.

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ogi flavour. The industrial production of *ogi* is based on an upgraded village method and the final product is a dry form of the starch cake that has a longer shelf-life.

A soybean-enriched variant called *soy-ogi* has about 15 per cent protein content and has been used to treat children suffering from kwashiorkor, a protein deficiency disease. Other well-known semi-solid fermentations are the fermented vegetable products of sauerkraut and the Korean *kimchi*.

The third type of fermentation, solid substrate fermentation, can be seen in the creation of soybean tempeh, a fermented product consumed as a staple food in Indonesia and other countries in Southeast Asia.

Tempeh manufacture involves a two-step fermentation process. In the first stage, soybeans are soaked in tap water for twelve to twenty-four hours during which an acid fermentation develops. After soaking, the soybeans are boiled in water, drained, cooled and then arranged in trays for the second fermentation, which is conducted with the fungus *Rhizopus oligosporus*. A mixed culture of bacteria and fungi occur, with the bacteria being very important in improving the nutritional content, in particular enhancing vitamin B12.

In Indonesia, tempeh is eaten by all sectors of the population and is often used as a substitute for meat among many low income groups as it is an excellent high protein food that can be preserved without the need for expensive refrigeration. It is also becoming increasingly popular among vegetarians in Western countries in the form of tempeh burgers.

Besides tempeh, other examples of such solid substrate fermentations include fermented meat products, cheese making and the production of *gari*, a staple in parts of Africa such as Nigeria.

UNESCO'S INTERNATIONAL NETWORK OF MICROBIAL RESOURCES CENTRES

The microbe is helping to free Third World farmers from dependence on costly chemical fertilizers

Progress in biotechnology depends to a large extent on the availability of microbes. To meet this need UNESCO, in active collaboration with the United Nations Environment Programme (UNEP), began in the 1970s to establish a network of Microbiological Resources Centres (MIRCENs) directed to the needs of developing countries. The first MIRCENs were six regional centres in Nairobi (Kenya), Porto Alegro (Brazil), Bangkok (Thailand), Dakar (Senegal), Cairo (Egypt) and Guatemala City. Although the MIRCEN concept applies mainly to the developing countries, "technical" MIRCENs began to be established in the 1980s in the technologically advanced countries, and today the UNESCO network comprises twenty-seven centres in twenty countries.

The MIRCENs provide facilities for the management, distribution and use of microbial gene pools world-wide, assist in the conservation of micro-organisms and encourage the development of new inexpensive technologies for specific regions. They promote the applications of microbiology to strengthen rural economies, and provide local centres for training, particularly in the developing countries. Each one has a special research interest. Several MIRCENs in developing countries are particularly concerned with research into biofertilizer technology so as to lessen their regions' dependence on expensive chemically derived fertilizer that may have adverse effects on the environment. The Nairobi MIRCEN has built up a venture whereby over 20,000 packets of quality-controlled biofertilizer or "black ash" are provided to farmers in Kenya and surrounding areas of East Africa.

Training is a particularly important activity, and many researchers, extension workers and industrial technical staff have benefitted from short courses and intensive on-the-job training programmes organized at the different centres. In 1991 UNESCO launched a scheme for short-term fellowships in biotechnology whereby scientists, particularly from the least developed and developing countries, can carry out research at a MIRCEN and learn to use techniques that are not normally accessible to them. So far 112 Fellowships have been awarded. For further information please write to:

UNESCO MIRCEN Short-term Fellowships in Biotechnology,
Division of Basic Sciences (Attn. Dr. E. J. DaSilva),
UNESCO, 1 rue Miollis,
75015 Paris, France.
Tel. (33-1) 45 68 38 83 - 45 68 41 82
Fax: (33-1) 43 06 11 22 - 45 67 16 90

***Nuoc*, a fermented fish sauce widely consumed in Asia, is stored in these containers at a small Vietnamese factory.**

Gari is a gritty, pre-cooked, dry starch food produced by fermentation of cassava roots. Although it is a good source of calories, it is deficient in proteins, vitamins and minerals.

Remarkable advances

Although the major commercial emphasis of biotechnology in recent years has been the production of recombinant proteins for pharmaceutical purposes, there are also many opportunities in food biotechnology that will make an impact on both developing and developed countries.

The new opportunities in food biotechnology can be grouped into four main areas: the improvement of microbial cultures, larger and improved fermentation processes, improved food properties and better detection of contaminations.

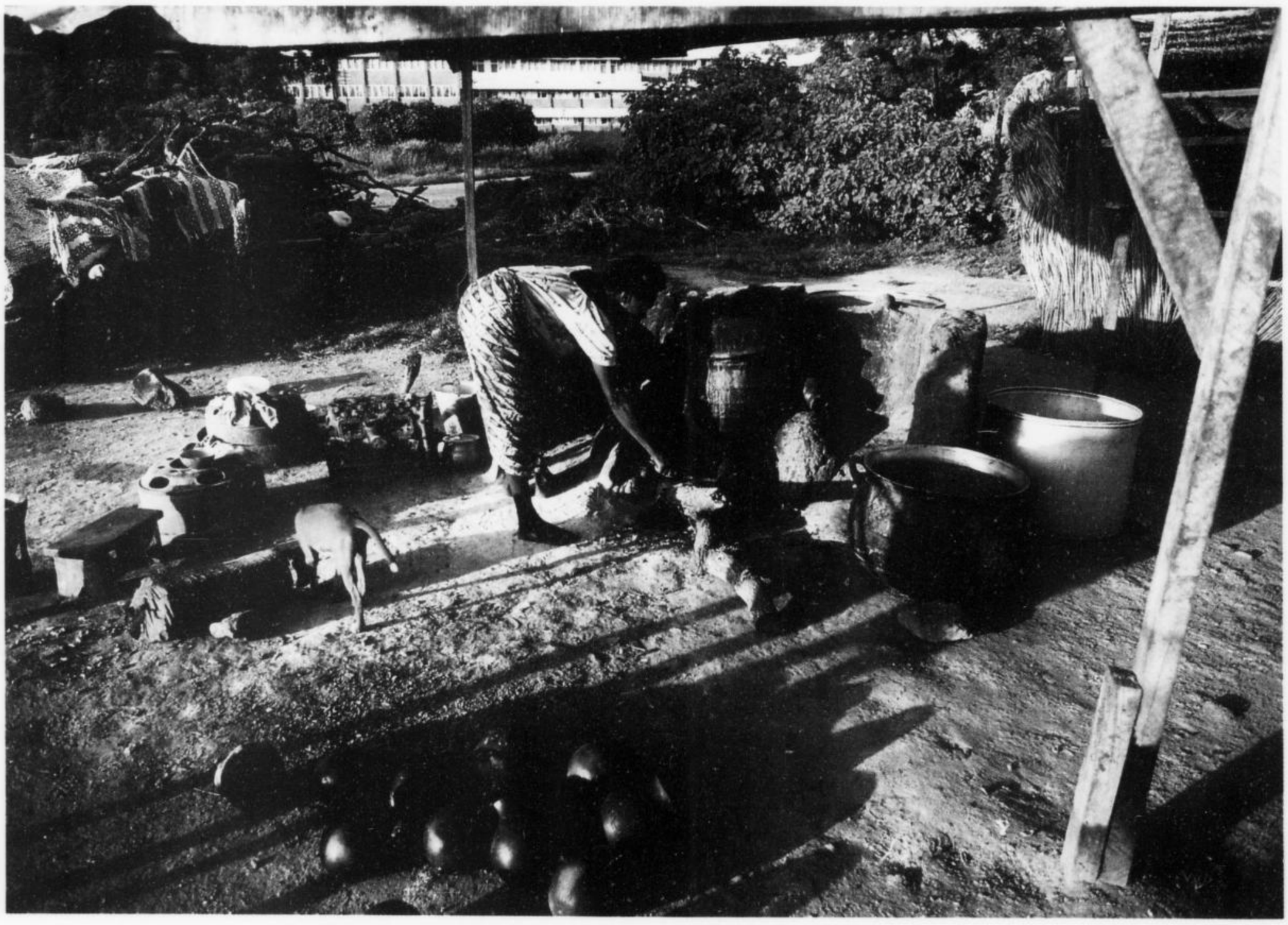
Many indigenous fermented foods are produced on a very small scale either in homes or in small-scale cottage industries in villages. In these situations, the microbial cultures are often traditional and highly variable. For example, some types of tempeh in Indonesia are produced by wrapping the soaked soybeans in a hibiscus leaf, which provides the natural flora for inoculation.

As our understanding of the microbial ecology of such fermented foods has increased, there have been efforts to produce a more standardized inoculum which would create tempeh of higher quality for the villagers. These programmes have been initiated by government research laboratories in countries such as Indonesia and Malaysia.

A similar pattern has emerged in developed countries involved in cheese-making: specific cultures of lactic acid producing bacteria are now being supplied to manufacturers for better quality cheeses. Techniques of genetic engineering are also being used to isolate new strains that are resistant to attack by various bacteriophages, small virus-like particles that can infect the usual lactic acid bacteria and cause the disintegration and dissolution of cells.

Food biotechnology can also lead to improved food properties. The main advantages provided by fermentation include higher vitamin levels and increased digestibility, better flavour and texture, and longer storage properties. Inoculation with selected micro-organisms can protect the foodstuff against breakdown by contaminating micro-organisms. In many cases, metabolic products of the fermentation process such as acetic acid (vinegar), lactic acid and alcohol provide natural inhibitory compounds. In other cases, the fermenting micro-organisms can produce natural antibiotics, which provide further protection against invaders. The use of these antibiotics in food preservation is likely to be an area of considerable importance in the future. ■

Brewing *pitto*, a kind of beer, in northern Ghana.



GREENWATCH

THE UNESCO COURIER — JUNE 1994

DEFEATING DECIBELS

BY FRANCE BEQUETTE

Traffic and low-flying aircraft are major causes of noise pollution in cities. Right, a Hong Kong street.

What is a drop of water? It's the best way of demonstrating how noise is transmitted. When a water drop hits the surface of a pond, it causes waves that spread outward in concentric circles, just as sound waves move through the air. Moreover when the drop strikes a resonant surface, it produces a noise that may seem like torture even if the impact is very mild. It is not so much the intensity of noise that makes it unbearable as its repetitive nature, the attention we give it and the impossibility of controlling it. Noise is becoming a threat to human health, and as such, ranks among the foremost environmental problems in the industrially developed countries that are member States of the Organization of Economic Co-operation and Development (OECD). "People consider noise to be the main local environmental problem, sometimes even more important than air pollution or the quality of drinking water," says an OECD study, *The State of the Environment*, published in 1991. Although they suffer just as much from noise, the inhabitants of developing countries don't talk much about it, largely because it is overshadowed by the demands of the struggle for survival.

Noise is a blend of sounds. Its frequency, i.e. the number of vibrations per second, is calibrated in hertz. The human being perceives sounds between 20 and 20,000 Hz, while elephants are sensitive to infra-sounds (less than 20 Hz) and bats and dolphins, though virtually blind, move about thanks to ultra-sounds that they emit at greater than 20,000 Hz. We experience the sound level, expressed in decibels (dB), as pressure on our

DEFEATING DECIBELS

ears. With the audible threshold being zero dB, 85 is the risk level, 90 dB the danger level and 120 dB the pain threshold. Beyond that the ear-drum may rupture.

NOISES THAT HURT

It is therefore easy to understand that too much noise can damage our ears. What is more surprising is that our health is affected in other ways too. There are immediate effects, i.e. cardio-vascular problems with an accelerated heartbeat and high blood pressure, gastric-intestinal problems, a decrease in alertness and ability to memorize, nervousness, pupil dilation and a decrease in the visual field. These effects may be temporary; others are longer lasting, e.g., insomnia, nervousness, bulimia, chronically high blood pressure, anxiety, depression and even sexual malfunctions!

Discomfort may arise from even very low noise levels. A couple, for example, lives in a small town. Next door there is a cock that crows at dawn. The wife doesn't mind, but her husband can't stand it. He wakes up early and waits for the cock to crow; when it does, he flies into a rage. This happens every morning until, rather than wring the bird's neck, the couple moves away. Another example. A sixty-year-old widow lives alone. A young couple moves into a semi-detached house next door that they've just built. The noise of their love-making enrages the widow, and she lodges a complaint. An expert measures the disturbance caused and notes that there is no possible effective sound insulation. The judge orders the young lovers' house to be pulled down; it is not in conformity with the legal norms of the building code.

Noise is a psychological fact. It contains an emotional element. In a manual entitled *Noise and Its Effects on Health* the French Ministry of Social Affairs emphasizes that "active, ambitious people with a sense of responsibility seem less bothered by noise than introverted people". It adds, "Certain groups are more sensitive to noise or are apt to be made more sensitive to it by specific factors: those prone to depression, hypochondria and anxiety or who are going through a difficult experience such as a divorce, unemployment or relational problems."

On the other hand deafness is the most indisputable effect of noise on people. An explosion of 140 dB can cause permanent deafness, for it destroys certain cells in the inner ear that do not regenerate. Permanent deafness can also occur gradually as a result of exposure to 85 dB sound-levels over several years. This level is not confined to factories where occupational medicine, at least in the rich countries, is trying to reduce noise levels. A rock concert emits as many decibels as a workshop for testing jet-engines. The noise-prevention brigade of Lausanne's city police department in Switzerland received permission to order the lowering of noise levels at a concert given by the singer Michael Jackson, after posting the following notice to spectators, "Bring ear-plugs or cotton".

Moreover, the craze for the Walkman has been held responsible for serious hearing problems among the young. Germany has calculated that noise-related health costs and payments made for hearing loss amount to nearly 4 billion dollars annually!

The noise of public-works machinery is highly unpleasant for operatives and anyone else who happens to be near. Left roadworks in Panama City.

INCREASING SOUND POLLUTION

More than a third of the 400 million inhabitants of the OECD countries are exposed to a daily dose of 65 dB, an unacceptably high level; 200 million live in an uncomfortable sound environment. The foremost culprit is road traffic. Between 1970 and 1988 in Japan, for example, the motorway network was extended by 510 per cent, while the number of motor vehicles increased by 200 per cent and total traffic grew by 126 per cent. Aircraft are guilty too. They constitute a nuisance for 2 per cent of the population in the United States, i.e. 5 million people, four times more than in Europe or Japan.

Trains disturb a smaller percentage of people, usually depen-

ding on their frequency, the density of the rail network and local topography. Factories, workshops and building sites, though increasingly well monitored, are no less a disturbance for a fair amount of the population, not to mention for the workers themselves. Among the sources of neighbourhood noise problems—the cause of countless complaints and court cases—are stereo systems and household appliances, joint-housing equipment and barking dogs.

What can be done about rapidly growing sound pollution? Australia is the champion for noise reduction. Some of its states require a "noise" label for chainsaws, lawnmowers and pavement breakers. When the police in the southern city of Adelaide spot an unsafe or noisy car on their roads, they present the owner with a "defect notice". The car's registration is suspended until it has been repaired in an authorized garage. In New South Wales noisy vehicles can be stopped and tested by the side of the road. The excellent results thus obtained are derived from close co-operation between the police and environmental officials.

However, Switzerland is the only country with legislation designed to ensure that the best possible technology for reducing noise is always used. It requires constructors, for example, to encapsulate already low-noise-producing truck engines. The costs are covered by the users. Moreover, the Swiss Society of Engineers and Architects has defined the required norms for sound-proofing building interiors: stairwells, lifts and heating and ventilation systems.

A NEW CHAPTER IN ENVIRONMENTAL PROTECTION

In Switzerland, as in France, Australia and Japan, the authorities are trying to promote the notion of "quiet" communities with reduced levels of industrial, traffic and domestic noise. In Australia big campaigns against noise, featuring posters proclaiming, "Be neighbourly, it feels nice" or "A quiet day", have a real impact on the population. In Switzerland the picture of a black cat on wheels encourages people to drive quietly. Unfortunately new problems are arising more and more urgently in the OECD countries, i.e. rapid increases in motor traffic, especially planes and trucks, increases in evening, night-time and weekend noise levels in rural areas, and a proliferation of motorized pleasure craft, Walkmen and ghetto blasters.

The history of sound is linked to the history of humanity. "The acquisition of language," writes sound engineer Denis Fortier, "then of chanting and music, has taken thousands of years of patient learning, the time required for the brain to learn oral and auditory communication." The Greek philosopher Pythagoras believed that music enabled man to harmonize with the cosmos, which, long before the theory of the Big Bang was formulated, ancient India believed was born from sound. Sound is vital for communicating, but when it becomes noise and a nuisance, it can also kill communication. From now on the fight against noise must be a part of any environmental policy. ■

"A rock concert emits as many decibels as a workshop for testing jet engines". Above, Joe Cocker at the 1976 Le Castellet pop festival in France.

FRANCE BEQUETTE
is a Franco-American journalist specializing in environmental questions. Since 1985 she has been associated with the WANAD-UNESCO training programme for African news-agency journalists.

THE SUN, FRIEND OR FOE?

The World Health Organization (WHO) believes that the public is not sufficiently aware of the dangers posed by overexposure to ultra-violet rays. As a result, an international research programme on health, ultra-violet sunlight and modifications to the environment (INTERSUN) has been launched by WHO, the International Cancer Research Centre and the United Nations Environment Programme (UNEP). It entails setting up a network of centres for monitoring solar ultra-violet radiation at ground-level, the exposure of populations to it and resulting health problems. Although small doses are beneficial—they help stimulate our production of vitamin D—prolonged or intensive exposure could damage our immune system and provoke skin and eye ailments. ■

THE FUTURE OF MIGRATING WASTE

The United States administration is seeking to ban exports of hazardous wastes except to Canada, Mexico, Japan and western Europe, and has asked Congress to approve a proposal to this effect. U.S. Greenpeace has welcomed the move, which would effectively ban the export of toxic wastes to most developing countries. In 1992 the U.S. Senate approved the Basel Convention, signed in 1989 by 116 countries, on the control of transboundary movements of hazardous wastes and their disposal. However, the U.S. cannot ratify the Convention until domestic law is changed to conform to its provisions. Under the Convention, importing countries must give their consent and must possess adequate disposal facilities. In practice, the bulk of the 130,000 metric tons of hazardous waste shipped by the United States in 1992 went to Mexico and Canada. ■

HOW TO WIN THE WAR ON HUNGER

According to Mr. Jacques Diouf, Director-General of the United Nations Food and Agriculture Organization (FAO), by the year 2000 there will be a billion more mouths to feed, yet there will be 15 per cent less cropland per head. Livestock is another major area of concern. *Ambylomma variegatum*, a parasite that attacks cattle, sheep, goats, horses and dogs, causes heavy financial losses. A programme exists for ridding the 14 already-infested Caribbean islands of the parasite within five years and preventing it from spreading to the American continent. And there is one success story to give us hope: the fight against the new world screwworm in north Africa was crowned with success. ■

RUSSIA CREATES A HUGE ARCTIC RESERVE

A year ago Russia decided to create a strictly protected zone of more than 40,000 square kilometres on the Taimyr peninsula on the northern Siberian coast, i.e. an area the size of Switzerland. This *zapovednik* or nature reserve, proposed by the Russian Academy of Sciences and the World Wide Fund for Nature (WWF), is the most arctic landfall for migratory birds. More than 150 species have been counted. There is also a wide variety of marine life: fish, seals and walruses, as well as polar bears and the world's largest herd of wild reindeer. The decision to "freeze" these lands, which are already affected by pollution from nearby industry, is all the more impressive since beneath them are deposits of precious metals, coal, oil and natural gas. ■

PACHAMAMA, MOTHER EARTH

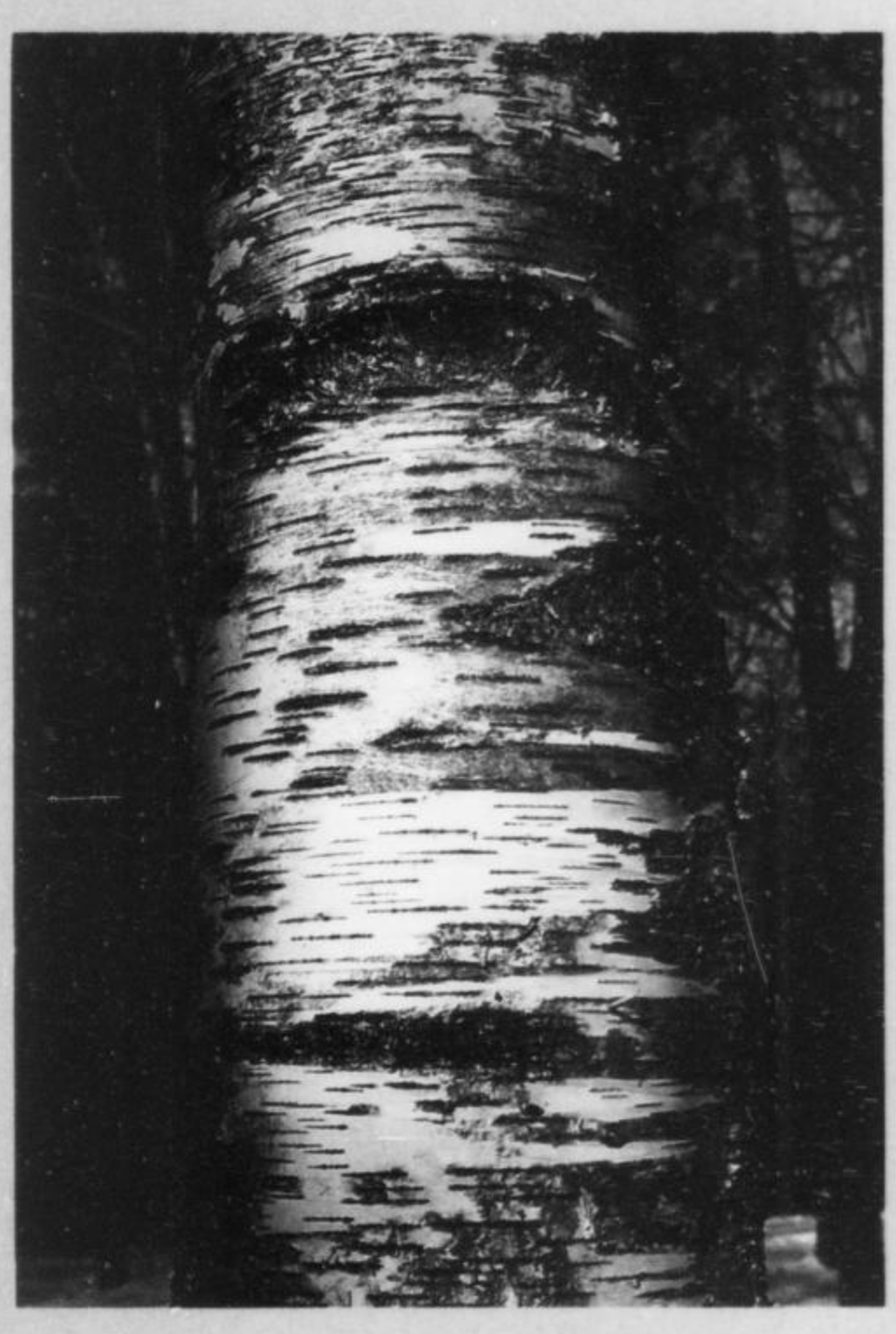
Manuel Vegas-Velez, an expert in marine biology, has written to tell us of his activities in Peru, a country rich in natural resources. Along its coastline, which bathes in the temperate waters of the Humboldt current, live 700 species of fish, 800 species of molluscs and more than 300 species of shellfish. Tropical rain forest still covers 61 per cent of the country's area, and minerals such as gold, iron and zinc are found there, as well as oil and natural gas. A non-governmental organization, Pachamama, has launched a range of projects to promote the wise exploitation of these abundant reserves. One project aims to restore fertility to hills eroded by coca growing. Another is concerned with managing the two new marine reserves of Mancora and the Illescas and Lobos islands to the northwest of Peru. This team of Peruvians, now a member of The World Conservation Union (IUCN), was self-financed when it began operations but is currently looking for assistance in order to carry out its programmes.
Address: Camino Real 479, Lima 27 Peru. Tel: (51) 1442-8948, Fax (51) 411-990. ■

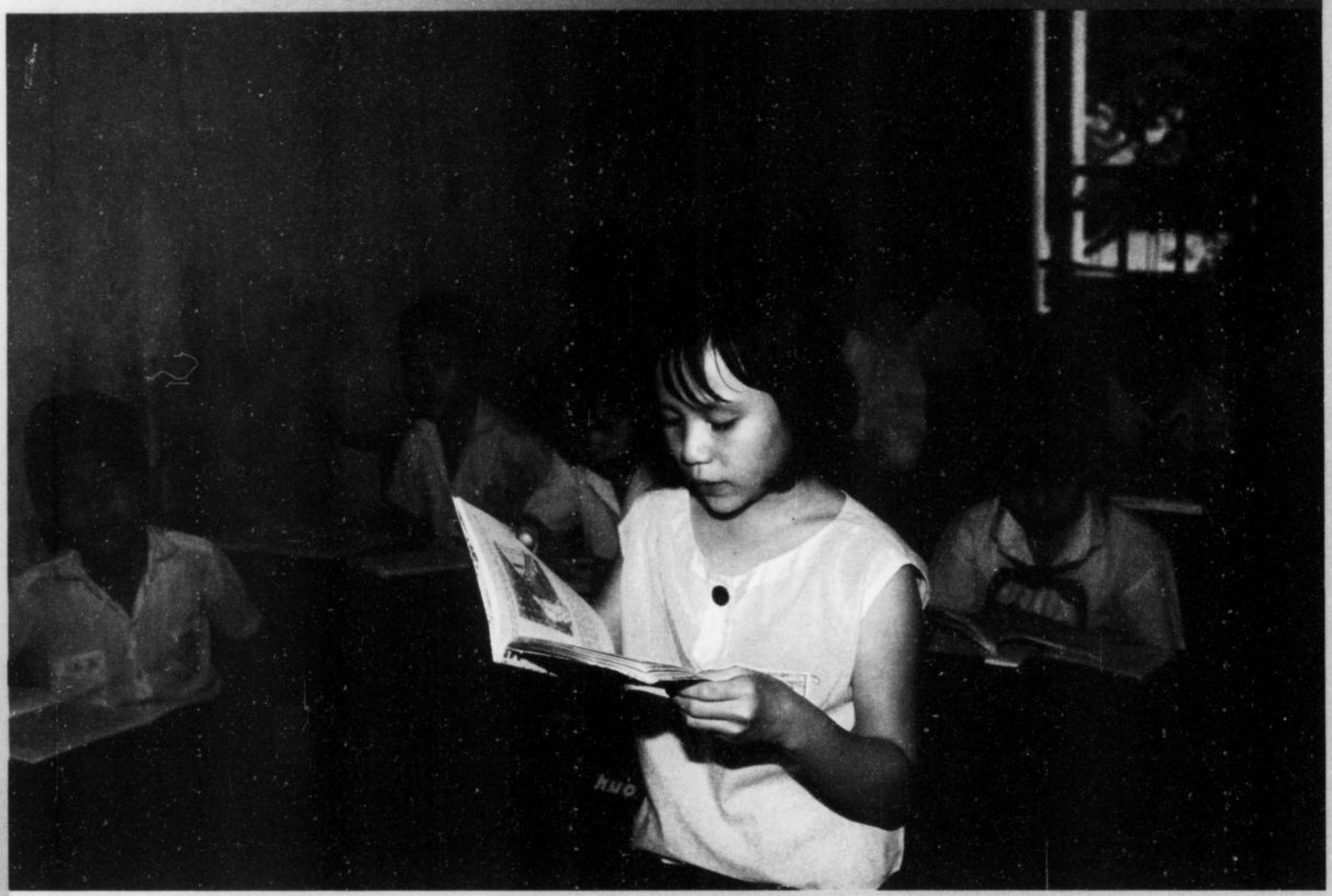
THE DANGERS OF CHEMICAL ACCIDENTS

The Organization for Economic Co-operation and Development (OECD) has published three guidance documents about chemical accidents. The first is designed to assist managers and other decision-makers in developing appropriate policies and plans of action. The second document is a more detailed and technical practical guide to action in the event of a chemical accident. The third, *Checklist for Action*, is aimed at persons with overall managerial responsibility for chemical accident contingency planning (in French and English). OECD, 2, rue André-Pascal, 75775 Paris Cedex 16, Fax (33-1) 4524-1675. ■

CANADA'S CONTEST BETWEEN FIR AND BIRCH TREES

After a forest-fire it seems to make sense that the new trees growing in should be the same as those burned down. Not so, say Ross Wein and Simon Landhausser, researchers at Canada's University of Alberta. Conifers, they have found, tend to give way to birches and poplars, a phenomenon they attribute to the climate, which is warmer and drier nowadays than at the beginning of the century and better suited to broad-leaved trees than to the cold-preferring cone-bearers. The light seeds of broad-leaved trees are carried by the wind and are gradually colonizing the northern regions at the expense of coniferous trees. Could this really be a proof of global warming? ■





THE LESSON OF EASTER ISLAND

Birth rates and child death rates both decline when countries expand access to health and family planning services and education for girls. Above, a school in Viet Nam.

Population Action International (PAI) is an American non-governmental organization whose work is inspired by a historical event. When a group of Polynesian voyagers arrived on Easter Island in the fifth or sixth century A.D., they found a plentiful supply of natural resources and created a unique civilization, now famous for its enormous and mysterious stone statues. But studies of fossilized pollens have shown that as the population grew, the lush green forest diminished, leading to a fatal erosion of the fertile soil and disappearance of the island's wildlife. When a Dutch traveller set foot on the island in 1722, he observed that it was completely barren. Deprived of natural resources, the 3,000 people living on the island spent their time fighting fratricidal wars. In other words, environment and population are inextricably linked. Human overpopulation exhausts the earth, which, in turn, can no longer feed that population.

In the past, as Population Action International (PAI) points out, "People altered local landscapes; today we are changing the earth itself. And the parables of the past send a warning: Nature has the upper hand. If human activities cause climate to warm dramatically or soil to wear out or water sources to fail, the risk to humanity will be incalculable". Yet as long as the world's wealth is not shared more equitably and children's health not better guaranteed, couples in the most disadvantaged nations will continue to resort to large families as a way to insure against old age.

Family planning is not PAI's only concern. It also conducts programmes for promoting studies for girls, especially in south Asia, the Middle East and Africa where the largest disparities in school enrollment exist between boys and girls. In 1992 it launched a population and environment programme, one of the results of which was an interesting pamphlet on water management for the planet. It is the first in a series of case studies analysing the effects of demographic pressure on natural resources.

PAI was founded in 1965 as a non-profit organization. It has an annual budget of about 3 million $US and receives no support from the American government or from multi-lateral agencies such as the World Bank or the United States Agency for International Development (U.S. AID), the policies of which it does not hesitate to criticize when it thinks fit. ■

Contact Robert Engelman, Director, Population and Environment Program, PAI, 1120 19th Street, suite 550, Washington D.C. 20036, Tel: (1-202) 659-1833, Fax: (1-202) 293-1795.

A RISING TIDE

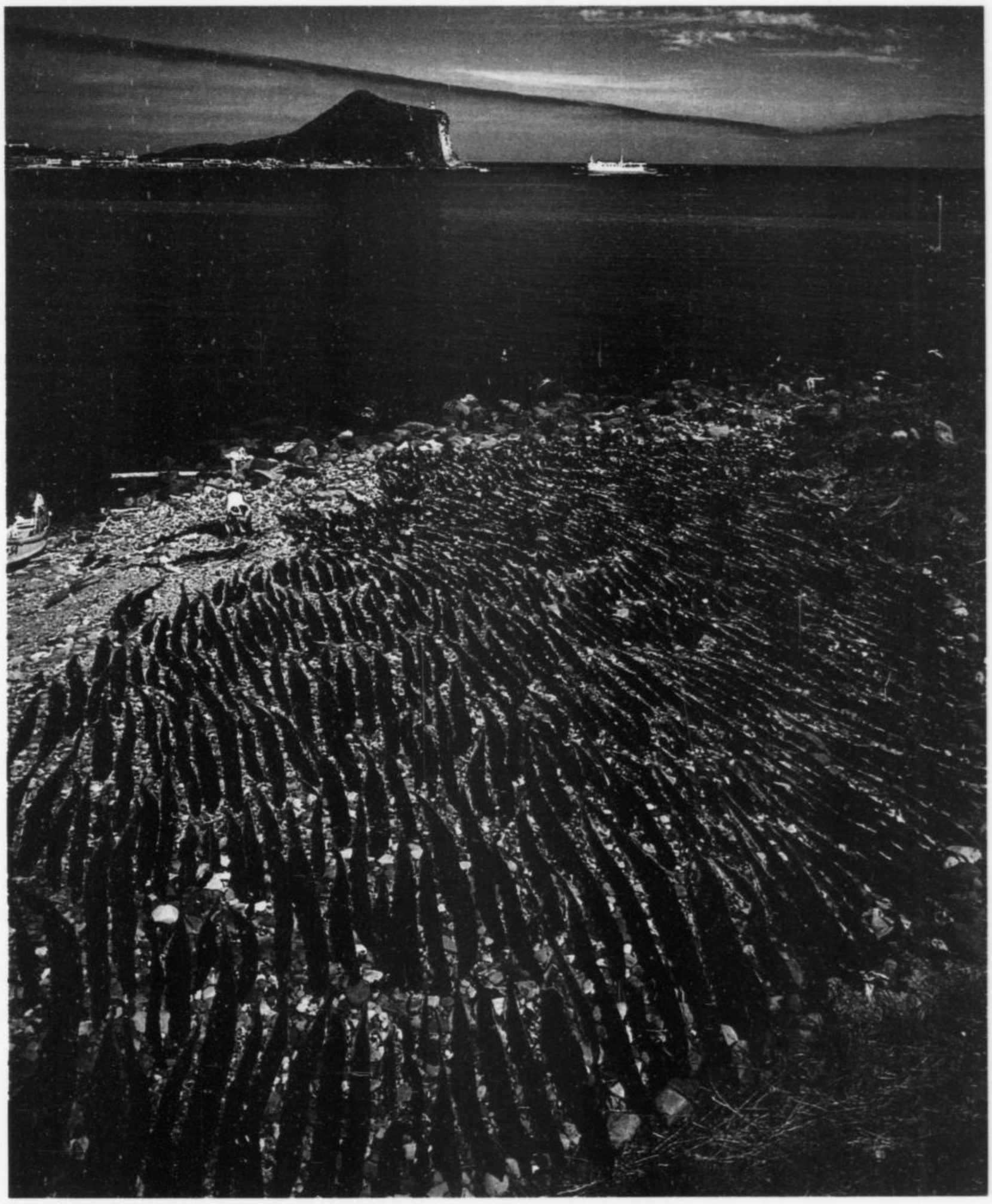
by Rita Colwell

Marine biotechnology is transforming our knowledge and use of the sea's resources

IT is only a decade since marine biotechnology was first recognized as an area of great potential. In that short span of time astonishing progress has been made.

Some of the most striking advances have been in the aquaculture industry, where direct genetic manipulation using recombinant DNA techniques has made it possible to develop an entirely new approach to fish farming. This is important because of the significant expansion of aquaculture in recent years. According to some estimates aquaculture may be supplying 25 per cent of world seafood consumption by the end of the century.

Fish are highly amenable to genetic manipulation because their eggs are large and can therefore be injected with DNA constructs. Major research efforts in genetic manipulation have been directed towards enhancing the growth and production of fish with superior



The *Kombu* alga is grown on Rishiri, an island adjacent to Hokkaido (Japan).

RITA COLWELL, of the United States, is President of the University of Maryland Biotechnology Institute. Adviser to several public bodies, national and international, she is a member of the Executive Board of the International Council of Scientific Unions and of the Scientific Advisory Committee of the United Nations University's Biotechnology in Latin America and the Caribbean programme. She is the author or editor of 16 books, author or co-author of several hundred papers and articles and produced an award-winning documentary, *Invisible* Seas, on marine microbiology.

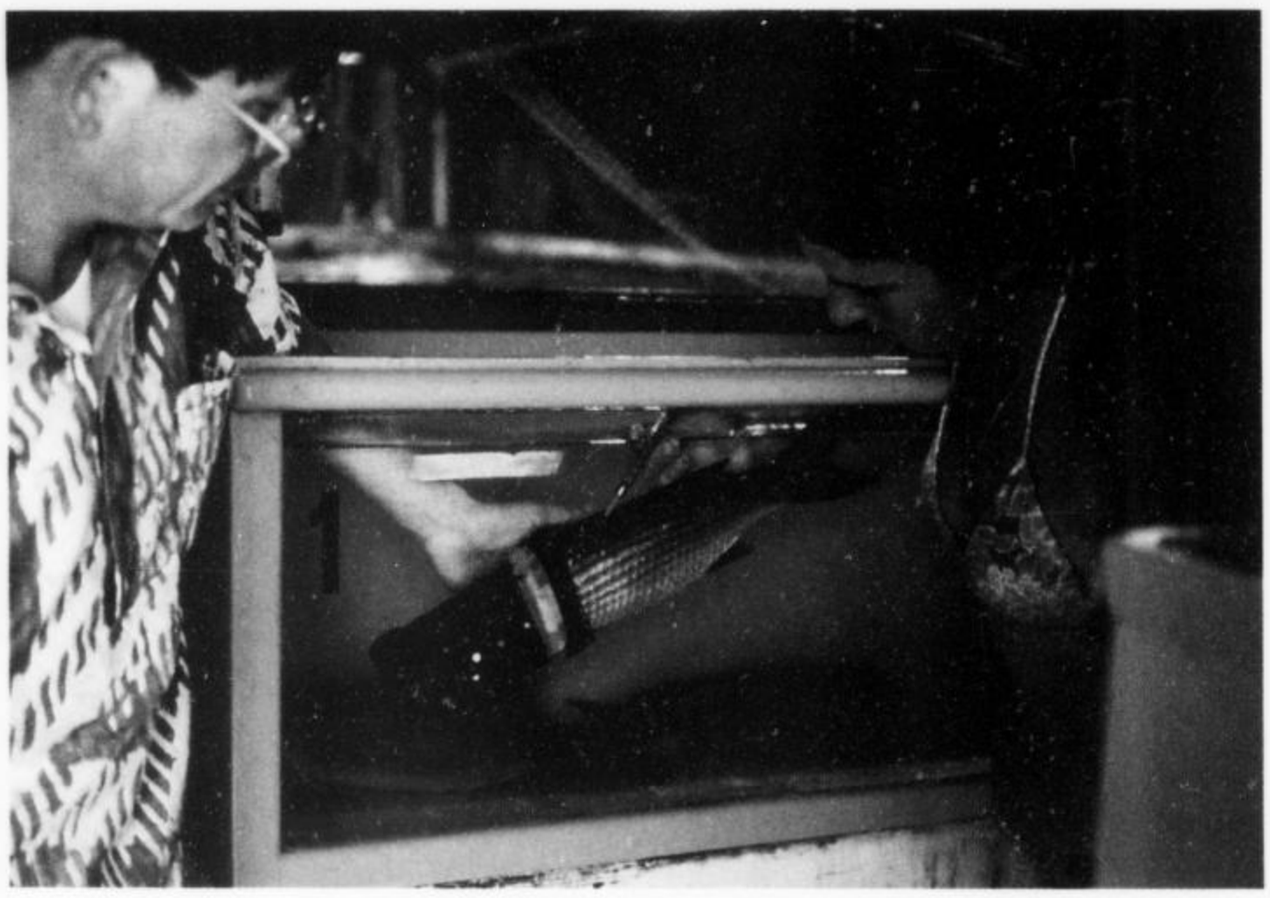
resistance to cold temperatures. With the spread of intensive fish farming and the concomitant increased risk of disease, the development of disease-resistant fish has also become an increasingly important objective.

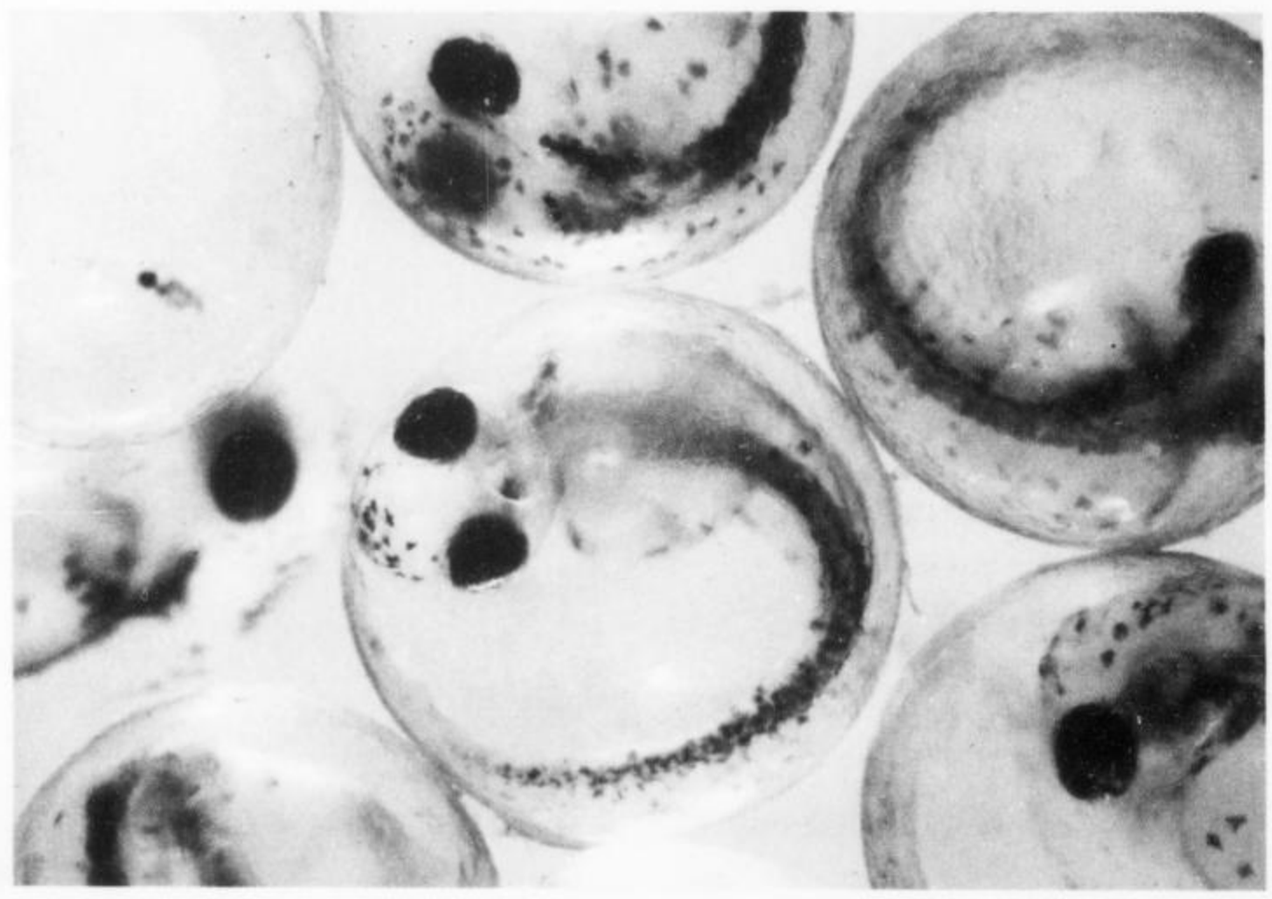
Goldfish with a human gene

The first successful growth hormone experiment using fish was the transfer into a goldfish of the human growth hormone gene, yielding offspring significantly larger than untreated fish. Since then, several vertebrate genes have been introduced into fish species, including Atlantic salmon.

Of more practical significance has been the achievement of growth enhancement using fish growth hormone. In several experiments, fish injected with growth hormone reached double the weight increment of untreated fish over a sixty-day period. However, as growth hormone is not easy to administer to fish, research is now focusing on generating transgenic fish. Up to 1990, thirteen transgenic fish species had been reported, including transgenic variants of commercial varieties such as the Atlantic salmon, channel catfish, carp and tilapia. Research is now underway to determine the physiological, nutritional and environmental factors that maximize the performance of transgenic fish. Major problems of safety and environmental impact must also be solved before large-scale, commercial production of transgenic fish will be permitted.

Below, a mullet is given an injection of hormones at the Hawaii Oceanic Institute.
Bottom photo, carp eggs seen through a microscope at Ahrensburg Scientific Institute (Germany). When they hatch, the alevin are kept immobile in heated water and fed with granules of egg white. They grow three times more quickly than in natural conditions.





Antifreeze for salmon

Genetic manipulation of Atlantic salmon has been carried out to try and increase the resistance of this species to cold. Many marine fish that live in cold water produce proteins which act as an "antifreeze" and protect them by inhibiting the formation of ice crystals in their serum. Atlantic salmon lack genes for the production of these proteins and therefore cannot survive in icy waters. However, genes coding for antifreeze proteins have now been transferred to Atlantic salmon, and the expression of adequate concentrations of these proteins in their blood could extend the range of environments where this fish can be grown.

Shellfish are also amenable to genetic manipulation, especially for enhancing their rate of growth and their size. It has been shown that bovine growth hormone can enhance the growth rates of California red abalone, and similar results have been reported for the application of biosynthetic rainbow trout growth hormone to young oysters.

Unlike fish and shellfish, anthropoids such as lobsters shed their exoskeletons during growth by means of a moulting process that is under hormonal control. Thus, regulation of moulting by the hormone-secreting endocrine gland may improve growth efficiency in the lobster. However, knowledge of the molecular genetics of marine crustaceans such as shrimp, lobster and prawns must be expanded before commercial production of these species will be efficient and reliable. Growth, development, and disease resistance have yet to be controlled.

One factor on which the successful exploitation of a fish or shellfish species in aquaculture depends is the ability to obtain consistent, controlled reproduction as economically as possible. It has been shown that water temperature and the period of daily illumination the fish receive can be manipulated sufficiently to improve spawning. Fortunately, some important advances have been made recently in the use of hormone treatment to control reproduction of fish species that are important in aquaculture.

The farming of marine macroalgae—seaweed—has been practised for several centuries in Asian countries, particularly Japan,

Above, dried *dihé*, a blue alga rich in protein, mineral salts and vitamins. It is harvested by women, top, in pools in parts of Chad, where it constitutes an essential part of the diet.

and products derived from them have been widely used as sources of medicine and food. Macro- and microalgae yield a wide range of products, including food additives and supplements, culture media, pesticides, plant growth regulators and antibacterial, anti-cancer and antiviral agents.

Seaweed for medicine and food

Microalgae have proved useful for large-scale production of fatty acids which may help to reduce the risk of coronary vascular disease. The green microalga *Dunaliella salina* is grown in large-scale, intensive culture in California to produce beta-carotene, a substance associated with the prevention of cancer. It has also been suggested that oceanic farming of marine algae could reduce global carbon dioxide levels.

The application of biotechnology to the cultivation of marine algae presents an opportunity for countries near rivers and the ocean, especially developing countries with extensive coastal regions. This potential is most likely to be realized by the formation of partnerships with industrialized countries. However, to achieve success, an understanding of molecular genetics and an application of the techniques of modern molecular biology will be required. Although molecular techniques have not yet been widely applied to achieve strain enhancement or the production of transgenic plants and algae of commercial importance, this approach is now being adopted in several laboratories in the United States, Asia and Europe.

Marine organisms are sources of a very wide range of natural products that have biomedical, biotechnological, agricultural and industrial applications. Chitin is one such product that has made it to market in a variety of forms—as poultices to heal wounds, extenders, and emulsifiers for photography—yet still remains a focus of extensive study. If and when the genes for chitin synthesis are cloned, the production of this compound will increase immeasurably since a stable source can then be obtained.

In the past decade, more than 1,000 new compounds, natural products, and other discoveries relating to the molecular genetics of fish and shellfish growth, metabolism and reproduction have been recorded. Promising new antibiotics, anti-cancer therapeutic agents, improved aquaculture stocks and food additives have either been discovered or are in the development stage. Where once only a few pioneers toiled in their laboratories, there are now major new centres of biotechnology research and development in Norway, Japan, the United States and elsewhere.

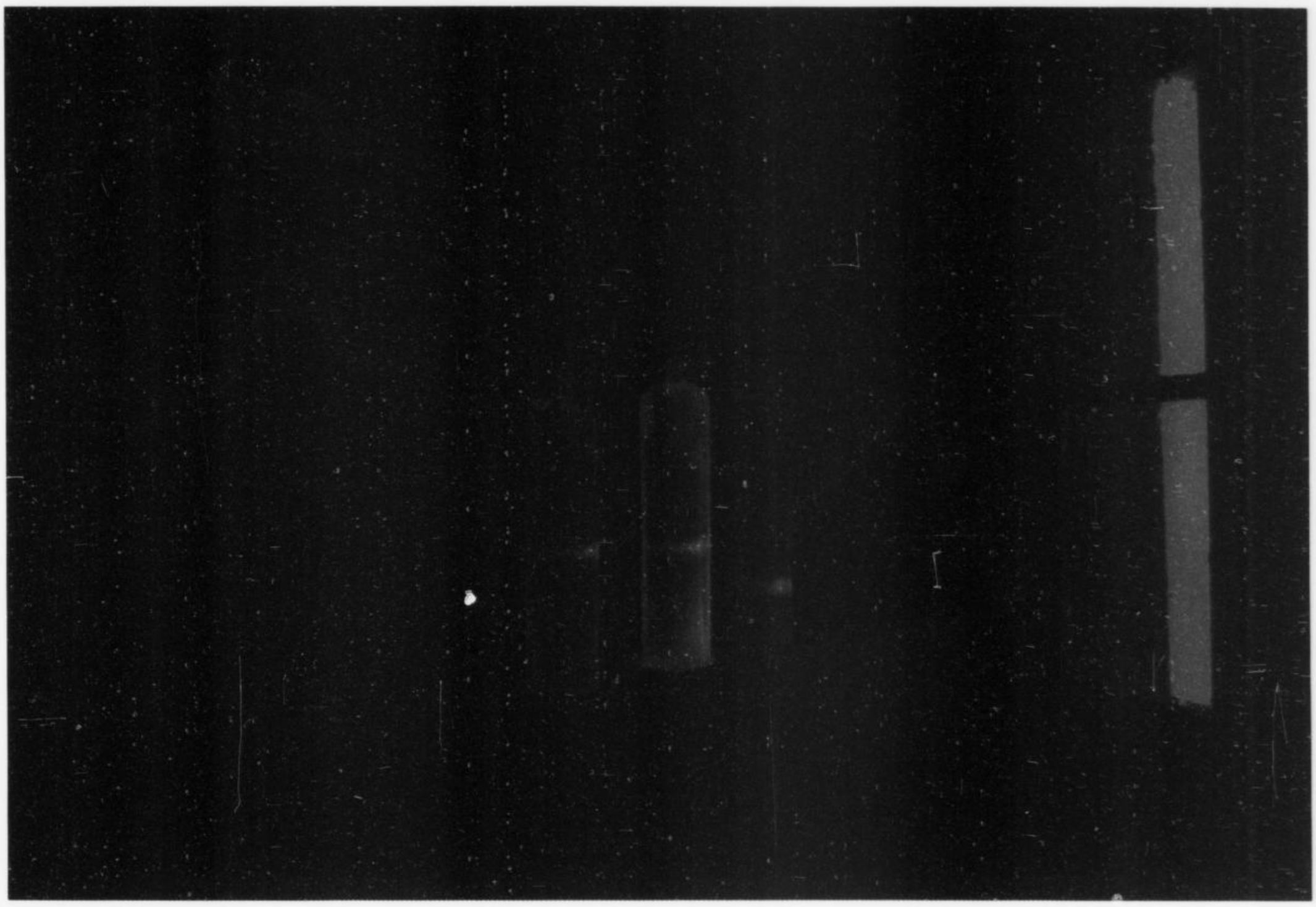
FROM THE GREEN REVOLUTION TO THE GENE REVOLUTION

by Indra K. Vasil and Luis Herrera-Estrella

Only biotechnology can make it possible to produce enough food to keep pace with the world's swelling population

THE rapidly-growing world population and increasing demand for more and better food are certain to pose serious threats to social, political, economic and environmental stability early in the twenty-first century. Without a decline in the current rates of growth, today's population of nearly 5.5 billion is projected to nearly double to 10.7 billion by the year 2030. Almost all of this growth will occur in the already overpopulated and impoverished countries of Africa, Asia and Latin America, which will be home to nine out of every ten human beings.

In this near future, additional land for growing food as well as for meeting all the other needs of the expanding population will have to be derived from the destruction of the already dwindling and endangered but precious protected natural areas. Undoubtedly, these changes will place unprecedented strain not only on the global, social, political and economic infrastructure, but will also cause further deterioration of the fragile environment of our already fully occupied planet. It is doubtful that world food production, which is barely adequate to meet today's needs, can keep pace with current rates of population growth. Indeed, in the past few years crop



In a U.S. Department of Agriculture plant genetics laboratory at Beltsville (Maryland) fluorescent bands of DNA are photographed under ultraviolet light. Left, growing improved wheat varieties in India.

yields have generally levelled off or have actually declined in many of the developing countries.

What can be done to reverse or at least forestall these dangerous and suicidal trends? First and foremost it is necessary to bring down the rate of population growth to a sustainable level. In the interim, food production must be dramatically increased. Scientists expect that plant improvement through the use of biotechnology will be an important part of this process.

Plants in the human diet

Ninety-eight per cent of global food production is land-based. Of the total human diet, 92 per cent is derived from plants, with no more than thirty plant species accounting for most of the calories and protein intake. Cereal grains like wheat, rice and maize alone provide more than 53 per cent of the world food supply.

Historically, major technological advances in agriculture have been a driving force for economic growth, political stability and social and cultural development. In recent history, the most dramatic results of agricultural improvement were those of the Green Revolution, which was based on the introduction and adoption of high yielding and otherwise improved varieties of wheat and rice developed at the international agricultural centres in Mexico and the Philippines, in close co-operation with national agricultural programmes.

The introduction of these varieties, particularly in Mexico, India, Pakistan, Bangladesh and China, in the mid-to-late 1960s helped not only to save millions from starvation and death but also to prevent widespread social and political unrest.

It was in recognition of this that the Nobel Peace Prize was awarded to Norman Borlaug, the American agronomist who developed varieties of "miracle" wheat in Mexico and played a seminal role in the introduction of such varieties in the developing countries of Asia and Latin America.

The benefits of the Green Revolution continue to be felt in the developing world. During the 1980s, agricultural production in China rose at an annual rate of 8 per cent, making it the largest producer of food in the world. In the developing countries as a whole, wheat and rice production increased by about 75 per cent in the fifteen years between 1965 and 1980. From 1950 to 1980, wheat production increased four-fold in Mexico, while rice production doubled in Indonesia. Similarly, wheat production in India increased three-fold in less than twenty years, from 1965 to 1983. The introduction of similar improved agricultural practices combined with high quality seed on a limited scale in parts of Africa, under the leadership of Norman Borlaug, has increased

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LUIS HERRERA-ESTRELLA, of Mexico, is Head of the Department of Plant Genetic Engineering at the Centre for Research and Advanced Studies, National Polytechnic, Irapuato, Mexico. He received UNESCO's Javed Husain Award for Young Scientists for his work on the genetic transformation of Latin American crops, particularly for resistance to plant pathogens.

the yields of maize, sorghum and millet by 300 to 400 per cent.

Plant improvement: a slow process

The process of plant improvement is painfully slow, however, and is generally limited to the discovery of useful genes in wild germ plasm and their introduction into commercial varieties during many years of breeding and selection. The process is also restricted to recombination of genes within the same or similar species because of biological limits to hybridization between unrelated species.

It is highly doubtful that conventional plant breeding alone can help produce the vast quantities of food that will be needed to feed the billions more people that are expected to inhabit the earth during the next few decades. It is in this context that biotechnology has attracted great attention, for it provides an excellent opportunity to supplement and complement plant breeding by providing mechanisms for the introduction of agronomically useful genes into crop species by overcoming all barriers to gene transfer between species.

In addition, it has already been demonstrated that crop species can be engineered to make them resistant to certain insects and viruses, as well as to compete successfully against weeds. Introduction of such technologies on a wide scale could immediately increase the amount of available food by more than one-third, by saving from destruction food that is lost to pests, pathogens and weeds. This would give us the needed time to integrate biotechnology into the traditional methods of plant breeding to improve the quantity and quality of food produced by plants.

If carefully planned, co-ordinated and implemented, plant biotechnologies could have such a profound impact on world food production as to bring about a Gene Revolution in the twenty-first century. It is vitally important, however, that the practice and benefits of plant biotechnology should not be limited to North America, Western Europe and Japan, where much of the current activity is concentrated, but be systematically introduced into the poor and developing countries where the needs are urgent and compelling.

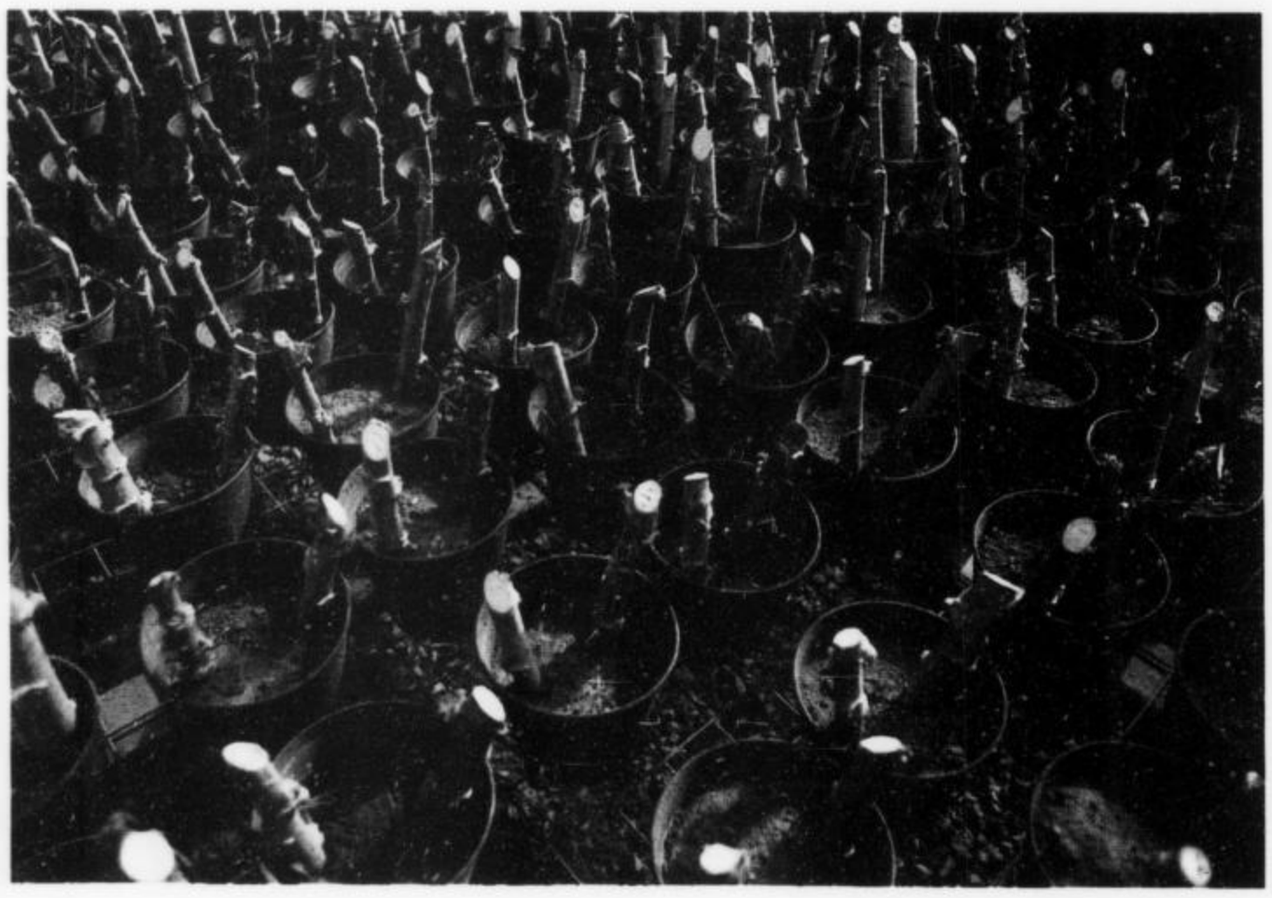
Simple, inexpensive procedures

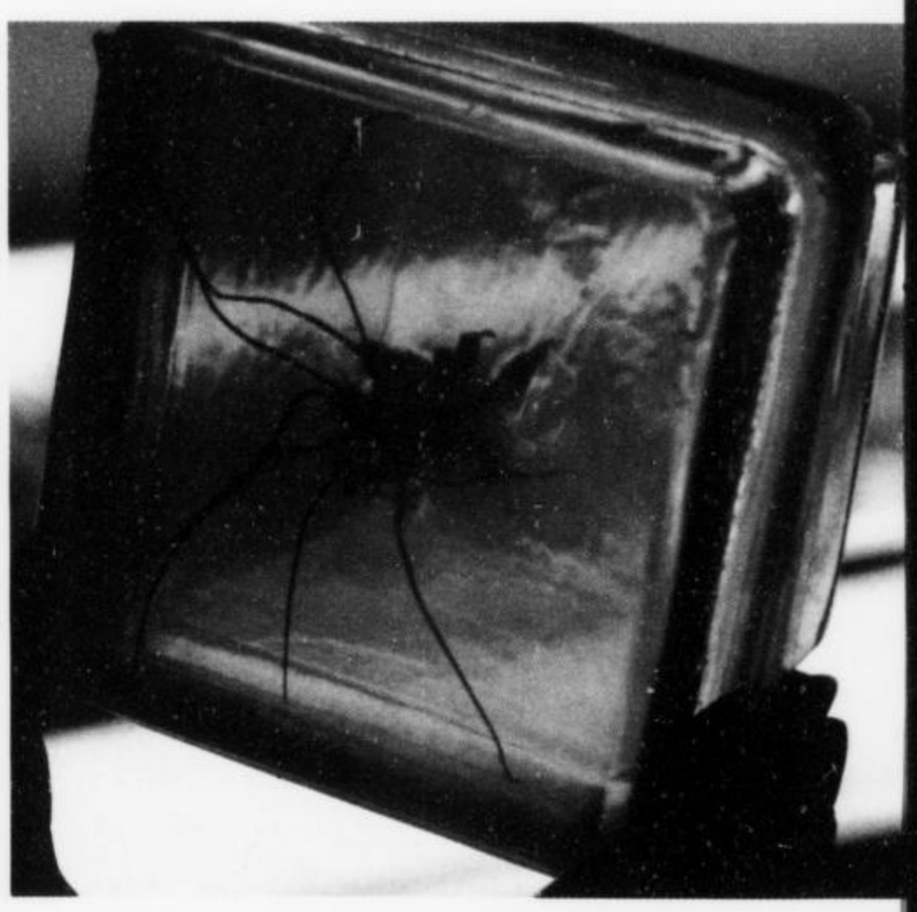
Plant biotechnology has two important components, one based on the use of tissue culture methods, and the other involving a combination of cellular and molecular biology. Each offers powerful methods for plant production and improvement. Many of the procedures involved are simple and can be practised without substantial investment in facilities and infrastructure for the rapid mass production and multiplication of plants.

One of these technologies is clonal propagation or meristem culture, the process that occurs when shoot buds of plants are isolated and placed in culture in the presence of plant hormones so that many new shoot buds form. Such buds can be separated from each other and induced to form roots and complete plants. Rapid, large scale and economical clonal multiplication is of particular value for many forest and fruit trees, plantation crops, endangered species and medicinal plants.

As a rule, one shoot bud placed in a culture can be made to produce more than a million plants in one year. The rate of multiplication can be further improved—and the costs substantially reduced—by automation of much of the process. It is significant that all the plants produced from the initial shoot bud are identical to each other as well as the source material. This is of paramount importance where a selected and valuable variety is being multiplied and no genetic variation is desired.

Below, cassava plants produced by cloning at the Institute of Tropical Agriculture, Ibadan (Nigeria).
Below right, a tiny peach plant produced in the laboratory by cloning.





The southern delta of Viet Nam is home to many varieties of valuable wild rice. However, the wild plants (at left in photo) are often considered as weeds by farmers and are being replaced by new varieties.

The well-established and reliable methods of clonal propagation are simple and do not require elaborate and expensive laboratory facilities. They can be easily and profitably practised as a small-scale industry at the village level, not only to provide quality material for plantings but also as a source of employment and earnings. This technology is potentially most useful for reforestation of vast areas in Asia, Africa, Latin America and Eastern Europe.

Global reforestation using this method can greatly reduce the damaging effects of pollution and acid rain, the dangers of the greenhouse effect, soil erosion and flooding, while preserving precious natural sources of energy and providing a natural habitat for endangered flora and fauna.

Another important use of meristem culture is the elimination of viruses, which cause more than 50 per cent yield loss in many crops, especially those which are propagated vegetatively, such as potato, sugarcane, cassava and banana. Cells at the extreme tip of a shoot are generally devoid of virus particles. Plants obtained from the culture of very small shoot buds are, therefore, free of viruses, and provide maximum yields of quality material. This technology is well established and can be practised on a large or small scale as necessary.

The most powerful and useful methods of biotechnology are those that involve genetic transformation, the transfer of genes, at the level of DNA, from one species to another. Two main strategies have been used for this purpose. The first and most commonly used method is based on a natural system offered by the soil-borne micro-organism, *Agrobacterium tumefaciens* (crown gall bacterium); the second uses the direct physical delivery of DNA from one organism to another.

The crown gall bacterium contains a circular piece of DNA, called the Ti (tumour inducing) plasmid. During normal infection of a plant by the bacterium, a part of the plasmid called T-DNA (transfer DNA) is transferred to the host plant cell and becomes permanently integrated into its nuclear DNA. The T-DNA contains left and right border sequences which are necessary for its transfer to the plant cell. In between are genes that control the synthesis of certain plant growth regulators that cause the crown gall disease.

Rice seeds are sterilized before being sent to the International Rice Research Institute at Los Baños (Philippines).

For directed plant transformation, the Ti-plasmid is disarmed by removing the genes responsible for tumour induction and replacing them with genes of interest. The useful genes are then transferred by the bacterium to the host plant cell during an infection process that does not result in the crown gall disease. Because of its simplicity and ease of use, this method has been used extensively since the production of the first transgenic plants (plants in which foreign genes have been transferred by genetic transformation) in 1983.

Unfortunately, for a variety of reasons that are still not clearly understood, the cereal grains such as wheat, rice and maize are not amenable to transformation by *Agrobacterium*. Fortunately, several methods of direct DNA delivery have been developed to produce transgenic cereals.

Currently, the molecular genetic improvement of plants is not limited so much by techniques for DNA transfer as by the relatively low number of agronomically useful genes that have been identified, characterized and cloned at the molecular level. The best characterized and therefore most widely used are the genes that confer resistance to insect pests, to viruses and to broad spectrum herbicides. Such genes have been successfully transferred to crops like wheat, rice, maize, soybean, cotton, oil seed rape and tomato. The transgenic crops are therefore protected from the enormous yield losses they would otherwise suffer as a result of pest and pathogen infestation, and competition with weeds for life-giving nutrients and water.

Major efforts initiated during the past few years to map the genomes of some important crop plants are expected to provide valuable information about the location and identity of other important genes—those that confer resistance to environmental stresses such as temperature, drought and salinity and those that control yield.

Saving plants from extinction

Thousands of wild plant varieties, which are valuable sources of useful genes, have either been lost forever or face imminent extinction as a result of the increasing destruction of natural forests for agricultural and urban use. Conservation of these irreplaceable resources for future generations and for the maintenance of biodiversity has thus become a global concern. In recognition of this, the Consultative Group on International Agricultural Research, which is responsible for the network of international agricultural centres around the world, has taken a step in the right direction by establishing the International Plant Genetic Resources Institute, with the mandate to conserve plant genetic resources. ■

Intriguing patterns of cross-fertilization have developped between microbiology and modern art

ART AND THE SCIENCE OF LIFE

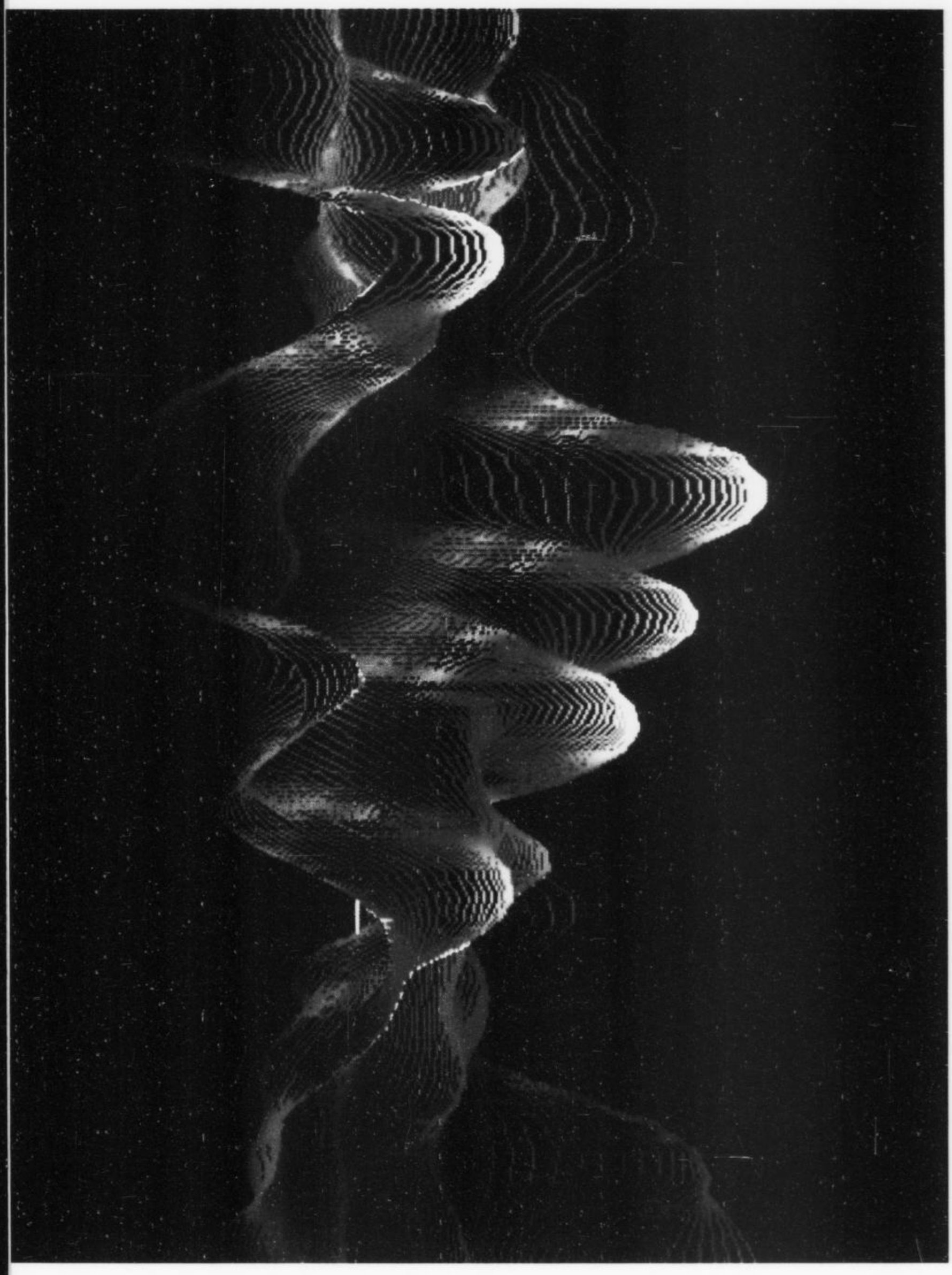
by John Hodgson

ART and science both endeavour to explore the mysteries of existence. Art does it by creating physical forms that reveal intangible subject matter or illuminate previously unconsidered aspects of the physical world. Science progresses by dissecting the physical world, assessing how each of the parts works first in isolation and then as a part of the whole. One significant difference between art and science, however, is the extent to which they concern themselves with telling people about their discoveries.

The archetypal scientist—caricatured as a person devoid of normal human drives, human emotions and human values—is concerned with the acquisition of knowledge. Moving from one piece of knowledge to the next like a hunter, he or she is generally unconcerned about communicating that knowledge to a wider public. Indeed, science often appears to build its walls high with the bricks of experiment and cement them together with quick-drying jargon and runic mathematics. In its keep are the precious jewels of knowledge, jewels that belong to everybody but are jealously guarded. In media reporting of science you will often find phrases such as "researchers have revealed" or "scientists have unlocked the secrets of", reflecting both the mystery that has become attached to science and the possessiveness about knowledge that has become attributed to scientists.

In art criticism, on the other hand, the stock phrases are "X shows us that" or "What Y is trying to say to us is", phrases that demonstrate the intrinsic role of communication in art. It is not enough for the artist merely to have had insight; if he or she cannot convey that insight to other people, then the art has failed.

We all have an interest in biology, even if it extends only to our personal health, longevity and ultimate mortality. Because biological science now has its public to please, biologists, perhaps more than any other scientific group, need to communicate widely. But even within the narrow confines of their profession, the

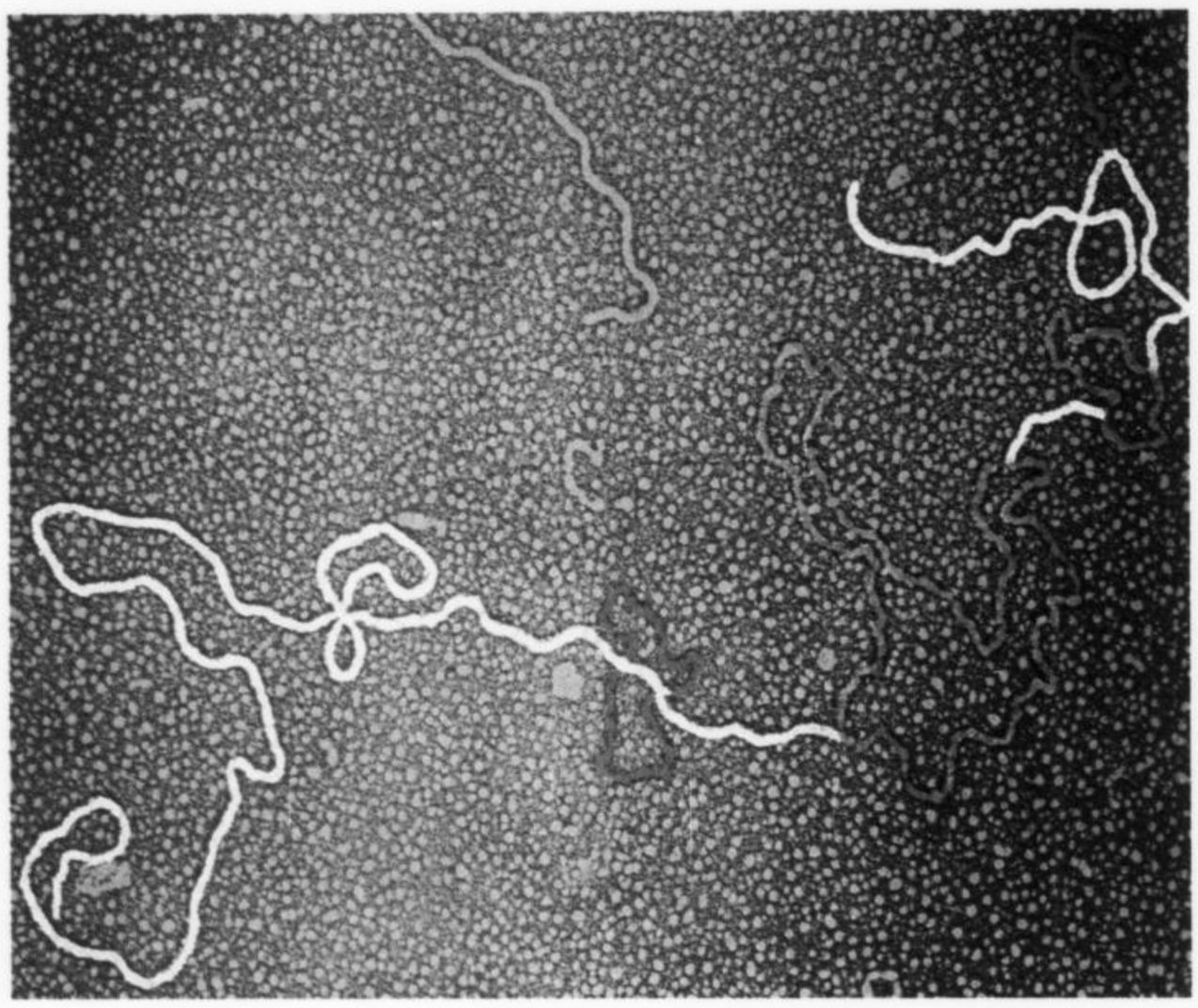


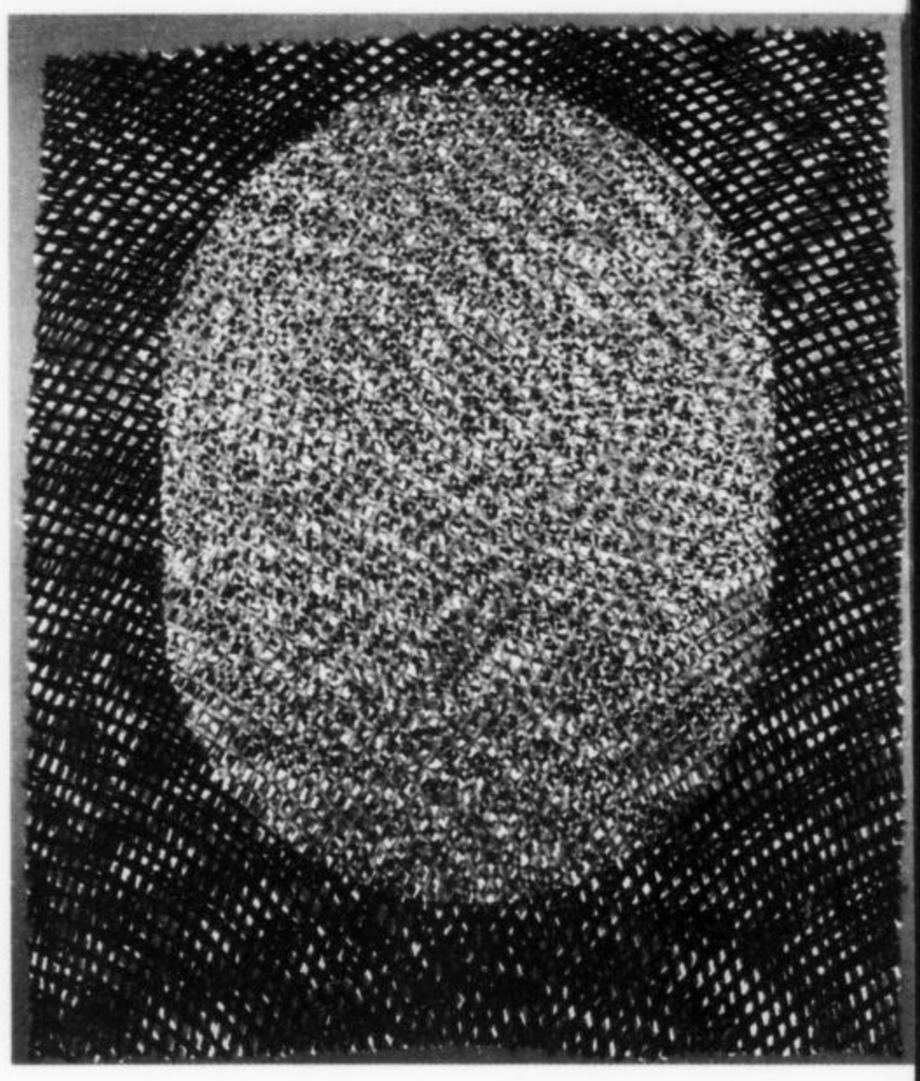
Left, false-colour scanning tunneling micrograph of DNA.
Above, *Pathway*, a Carrara marble and sheet plywood sculpture (122 cm high, 30 cm diameter) by the British artist John Maine.

imprecise nature of living organisms—even the simplest bacterium or virus—decrees that biologists cannot call upon precise formulae to describe their discoveries. They need to invoke artistic forms.

For instance, proteins, which are responsible for most metabolic processes, are often depicted as winding ribbons, reminiscent of Maurits Escher's graphic art. This style of representation was developed by Jane Richardson, a highly-regarded researcher at Duke University in North Carolina. Richardson's work is the design of completely new protein molecules based on information she has gleaned from existing natural proteins. Part of her contribution to her field, however, has been her ability to capture certain qualities of proteins by depicting them in certain ways.

No protein actually looks like Richardson's ribbons. In fact, no protein could ever be seen at all because the wavelength of visible light is too long to resolve the detailed structures. Proteins are "visualized" through a combination of X-ray light and computer analysis, a combination that produces the Escher-like images. However, the ribbon provides a useful





way for scientists to think about proteins because it illustrates the way that the complex chemical chain that makes up the protein winds round on itself.

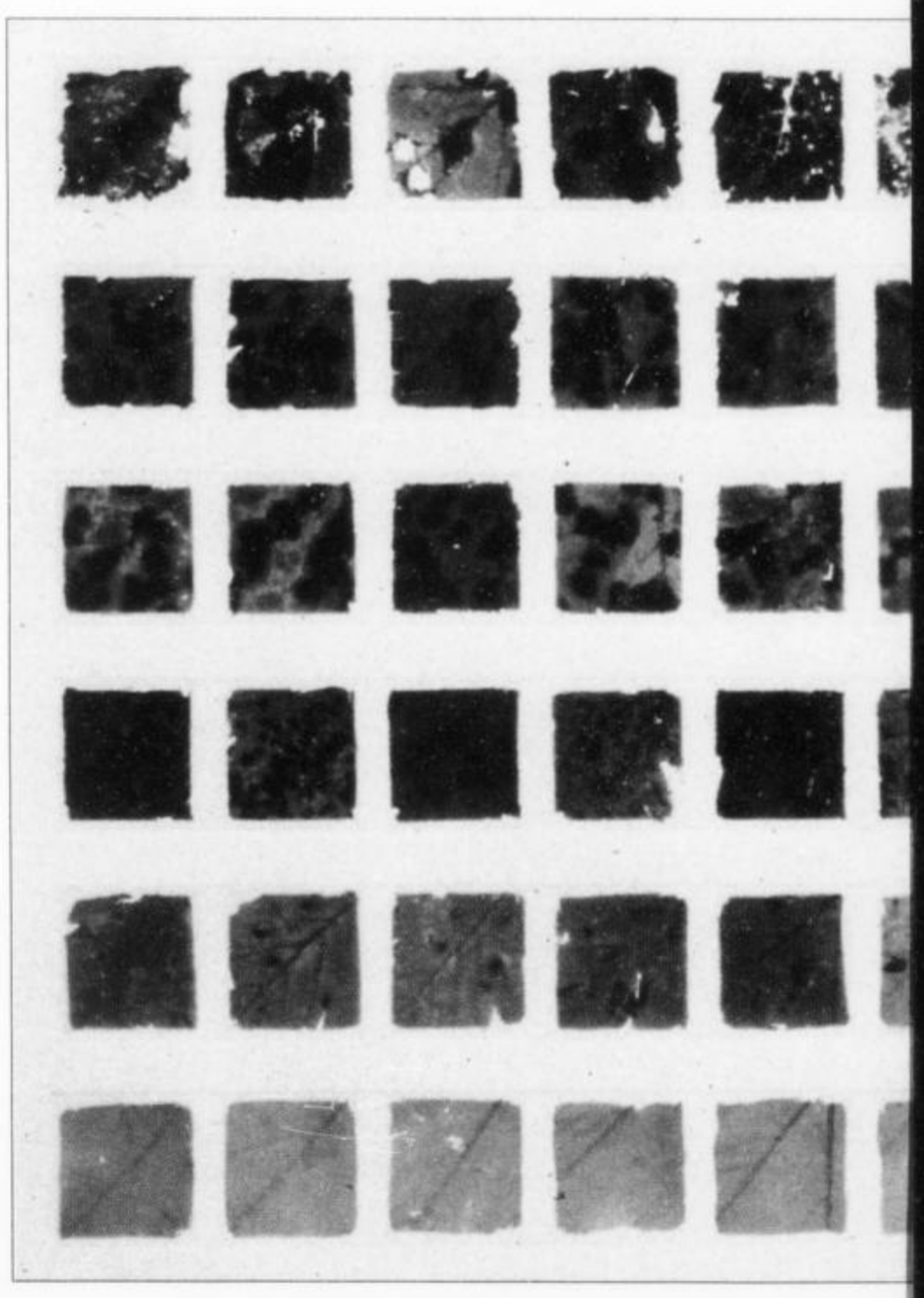
By adjusting the computer analysis, proteins can equally well appear as pointillist paintings, as similar to the works of Salvador Dalí or as architectural drawings. There is no "correct" way of depicting a protein. What needs to be recognized, however, is that the way scientists visualize the molecules does influence how they think about them.

Above, hand-tinted electron-transmission micrograph showing the DNAs of two bacterial viruses partially spliced together. Where the two DNAs are spliced together they are coloured yellow. Above right, *Untitled* (1988), oil on canvas by Noel Forster (United Kingdom).

Conveying emotions

Just as an Impressionist painting is not a photograph but an image that can convey a sense of emotion or atmosphere, images of proteins and other important biological molecules can, if portrayed in a suitable fashion, indicate a whole range of properties of the molecule. For instance, some regions of proteins are known to be very mobile; but how can you show that in a two-dimensional image? One of the solutions that protein chemists have come up with is to use "glowing coal" images; mobile parts of the molecule are represented by yellow and orange colourations while static regions are much darker. There is probably a good case to be made for showing the regions where the structure is uncertain as soft-focus images.

An appreciation of aesthetics can be important for scientists who wish to understand the mechanisms of biology. Perhaps the best example of this is the work of James Watson and Francis Crick in elucidating the structure of the fundamental heredity material, deoxyribonucleic acid (DNA) in 1953. Watson and Crick performed very little experimental work on DNA; instead they attempted to build models of DNA based on the research findings of other scientists. One expectation they had, however, and adopted as a guiding principle, was that the structure of DNA would have an inherent beauty. This enabled them to eliminate some of the possible structures as inelegant or downright ugly. The symmetrical molecular structure that they developed in 1953 has stood the test of time and has become an icon of the revolution in biological understanding.



***Coexistence Human-Vein Air-leaf Parasite-Tree Sun-Breath Fragility.* Sycamore leaves on wood panel (118 x 191.8 cm), by the British artist Garry Fabian Miller.**

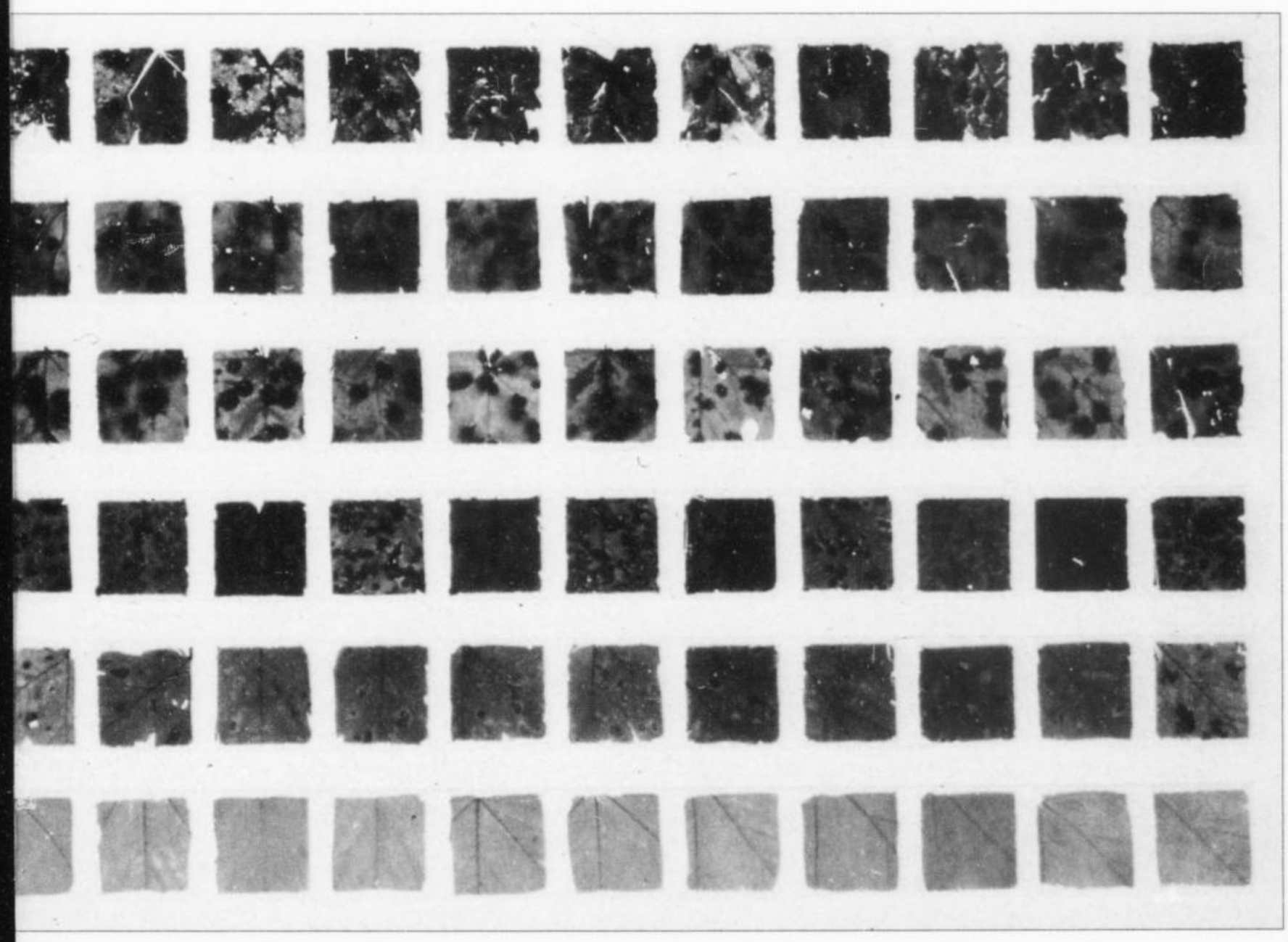
If biotechnology is undoubtedly being enriched by the application of artistic considerations, the reverse is also true. The forms of molecules and organisms that are first seen by scientists, even if they have not inspired art, can certainly find parallels in recent art. The helical structure of DNA, for instance, is reflected in John Maine's plywood and marble sculpture, *Pathway*. Noel Forster's untitled oil painting shows a weaving, bullet-shaped pattern which is highly reminiscent of the false-colour pictures of viruses produced by electron microscopists. And the images that neuroscientists produce of nerve cells in the brain are extraordinarily similar to paintings such as a red gouache work produced by Anish Kapoor in 1989.

Similar parallels can be seen earlier in the century. The American artist Alexander Calder's *Calderberry Bush* of 1932 is one of the artist's free-standing mobiles. In the way the size of the red disks increases, the work reminds one of the molecular machinery that is present in all living cells for the synthesis of proteins. The same theme is expanded in Calder's 1939 *Four leaves and three petals*, in which protein synthesis appears to be taking place on an undulating framework. That framework has its equivalent in what is called the "endoplasmic reticulum", a sort of membranous network that spreads throughout the cell and forms a kind of work-bench on which protein synthesis takes place.

Whereas Calder used three dimensions, the Catalan artist Joan Miró expressed similar images in two dimensions. Much of Miró's work appears to depict simple cell-like structures that have various functional forms dotted inside them. These forms closely resemble mitochondria chloroplasts or other sub-units of cells.

For me, one of the most provoking and biotechnologically relevant pieces of modern art is Garry Fabian Miller's arrangement of sycamore leaves, which goes by the rather extended name of *Coexistence Human-Vein Air-Leaf Parasite-Tree Sun-Breath Fragility*. Miller has taken square sections of sycamore leaves in various states of health and decay and arranged them on a panel. As one views the work from left to right and top to bottom the leaves become progressively more decayed until the final squares show nothing more than a leaf skeleton.

For me, the work illustrates both the perennial and natural process of autumnal rotting and the role of interacting organisms in this process. It is clear that many of the leaves are being degraded by cellulose-eating fungi and these fungi are an integral part of the recycling process. Looked at from a biotechnological point of view, the work reminds us of the importance not only of trees but also of fungi. Biotechnologists use fungi for antibiotic production, for traditional and modern food-making processes and for solving problems in waste disposal or recycling. On a more global scale, the Miller piece also brings home the self-sustaining nature of biology and the dependence of human life on the cycle of growth and death in nature. ■



JOHN HODGSON, a British microbiologist, is senior editor of the London magazine *Bio/Technology*. He has written widely for the press and has been responsible for drafting several governmental reports and brochures. He is the author of *Biotechnology-changing the way nature works*, and is the publisher and editor of *The Genetic Messenger*.

NEWSBRIEFS... NEWSBRIEFS...

PALOMA O'SHEA AWARDED THE PICASSO MEDAL

On 2 February 1994, Paloma O'Shea (Spain) was presented with UNESCO's Picasso Medal by Federico Mayor in recognition of her activities for the promotion of Spanish culture. President of the Isaac Albéniz Foundation, she has for over twenty years devoted herself to promoting music and young musicians and, among her other achievements, was responsible for creating the prestigious Santander international piano competition. UNESCO's Picasso Medal has rewarded artists and personalities in the world of the arts since 1981 for their contributions to international cultural dialogue. Past winners include Yehudi Menuhin, Ingmar Bergman, Nadine Gordimer and Pina Bausch.

PROTECTING MOENJODARO FROM THE ELEMENTS

The protohistoric site of Moenjodaro, which is included in the World Heritage List, is exceptional for its size, its town planning and the artefacts collected on the site. The vestiges of this brick-built city are, however, at present under serious threat from the floodwaters of the nearby river Indus and the capillary rise of groundwater; humidity and salt are eroding the walls of the buildings. International archaeologists and scientists are working together to save Moenjodaro from destruction. Experts from UNESCO are currently at work installing a monitoring station that will determine the exact relationship between the degree of humidity, which may also be coming from the atmosphere, and salt absorption. Among the several protective measures already implemented are the laying of new salt-free mudbricks, the coating of the outside faces of the walls with mud mortar, and the covering of some buildings with geotextile material.

1995, THE YEAR OF LOUIS PASTEUR

UNESCO will participate, in 1995, in the commemorative activities marking the centenary of Louis Pasteur's death. Pasteur's brilliant research in the fields of microbiology, immunology and fermentation technology, his inspired insights that led to the development of vaccines, his scientific rigour and his moral qualities make him one of the great benefactors of humanity. An inaugural ceremony at UNESCO Headquarters in Paris on 17 January 1995 will be followed by high-level symposia, on subjects dealt with by Pasteur, to be held in different regions of the world: From Spontaneous Generation to Molecular Evolution (February, Rio de Janeiro), Epidemiology and Public Health (March, Hanoi), Etiology and Pathogenesis of Infectious Diseases (April, Dakar), Microbes, Environment, Biotechnology (May, Tahiti), Stereospecificity and Molecular Recognition (September, New York) and Vaccines (September, Paris). Other centenary activities include a travelling exhibition and the striking of a commemorative medal.

MARISA BERENSON, UNESCO GOODWILL AMBASSADOR

"It is not always easy, when one belongs, as I do, to the exclusive world of cinema, to convince others of one's good faith in wanting to serve an ideal", said Marisa Berenson upon being named UNESCO Goodwill Ambassador on 23 March. A member since 1993 of the Administrative Council of the International Fund for the Promotion of Culture, the celebrated American actress initiated the Artists with a Difference project, which is committed to combatting the exclusion of disabled artists. As one of her first tasks, Ms Berenson will set up an international committee to help and support UNESCO's important projects. Marisa Berenson joins a circle of men and women who have distinguished themselves by their talent and their commitment to UNESCO. Placido Domingo, Ivry Gitlis, Ikuo Hirayama, Miguel Angel Estrella, Yehudi Menuhin, Marcel Marceau and Jean-Michel Jarre are among the artists already named UNESCO Goodwill Ambassadors.

EDUCATING CHILDREN WITH DISABILITIES

About 80 per cent of the estimated 200 million disabled children in the world are living in developing countries, and very few receive good health care and education. Fewer than 2 per cent receive special services of any kind. UNESCO has devoted a new 64-page booklet to them, setting out the key principles governing the education of young people with disabilities and reviewing the provisions (legislation, administrative, educational, etc.) being made for them. The booklet, entitled *Educating Children and Young People with Disabilities*, is available free of charge from UNESCO, ED/BAS/PE, 7, Place de Fontenoy, 75352 Paris 07 (France), Fax (33-1) 4065-9405. ■

THIS ARTICLE IS ONE OF A SERIES IN WHICH THE DIRECTOR-GENERAL OF UNESCO SETS OUT HIS THINKING ON MATTERS OF CURRENT CONCERN

UNESCO IN ACTION

COMMENTARY BY FEDERICO MAYOR

Sharing the future

LOOKING towards the future, I think UNESCO's role could be summed up as fighting for human dignity and solidarity, both of which are inseparable from respect for freedom.

North and South alike are doomed not only to suffer the same endemic ills that go together with underdevelopment but also to consume the same products, whether they be dreams or material goods, exported by the industrially developed nations. In both, we are witnessing the growth of sprawling monster cities, with their mixture of splendour and squalor, vast agglomerations where alienation and the worst kind of solitude, that experienced in the midst of crowds, are rife; where extreme poverty radicalizes the emotions and the longing for justice degenerates into hatred and violence; where the well-to-do, blinkered by their own affluence, see no promise for the future other than that held out to them by "market forces" alone.

Well-being, democracy, freedom and education are not rewards to be conferred by one set of people and gratefully accepted by another. They develop, find expression, take shape and attain fulfilment in each one of us. Scientific and technological advances are indeed necessary in order to facilitate this process, but they need to be applied judiciously and in moderation, since if they go too far they could have the opposite of the desired effect, lulling and inhibiting us and making us the slaves of our handiwork instead of its masters.

A single road

This is why I would assert that the culture of peace calls, at all levels of decision-making but especially at the highest level, for a clearsighted and at the same time open-hearted perception of the historic change now under way.

We must not cling to the past, merely taking stock and laying stress on past achievements. Time has become the most valuable of commodities, and we do not have enough of it. Since we cannot draw up an inventory before we set out, we shall have to do so as we go along. We have to set off on the road to the future, without undue haste but resolutely—the same road for all, not just for a chosen few, involving a process of change whereby civil society progressively comes to occupy those areas of activity that the state will have to hand over to it. The creation of ever-wider interfaces, especially at the local level, is absolutely essential if, in spite of wounds that are still fresh and painful, there is to be a reconciliation. Regardless of our different outlooks, we must all unite so that our paths converge and combine into a single road, pluralist and integrated, where each is mindful of our common future.

We must advance united, or rather reunited, in pursuit of a grand project to usher in, at the end of the present millennium, peaceful coexistence, justice and freedom, worldwide interaction and a form of competition that preserves identities and diversity. History is something to be written and made, not described and viewed from outside. The sole protagonists of progress and its only beneficiaries must be human beings—individual men and women—and it is up to each and every one of them, exercising their rights to the full, to shape their own destinies.

It is unimaginable that such a process, whereby each individual is given a chance to be listened to and to play a part, could take place in an atmosphere of isolation and distrust. It calls for a thorough educational approach. As the great Cuban patriot José Martí said with prophetic insight, "Education means pulling individuals up to the level of their time".

Ready for dialogue

In the first instance, the lifting of barriers and the removal of obstacles will allow contacts to be revived and dialogue to be established as we look to the future. The ideal dialogue is sometimes said to be that between grandparents, who have lost their memory, and grandchildren, who do not yet have memories. We would do better to ensure that our children's memory is not like ours nor like that which our grandparents have already lost.

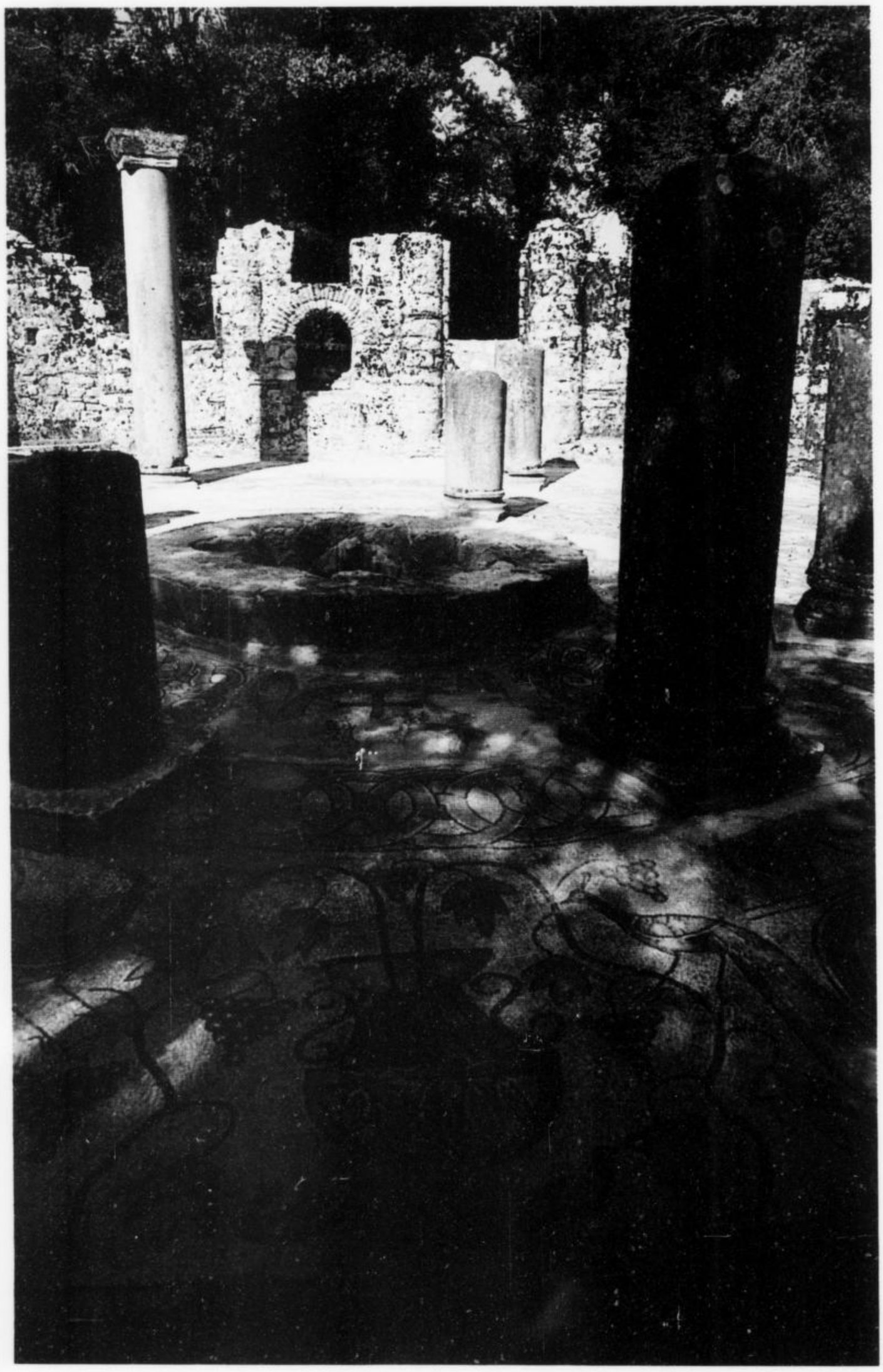
Let us open doors instead of shutting them; let us build bridges instead of destroying them. If we are to be stubborn, let us be stubborn only in our resolve to engage in dialogue and in our endeavours to discover new ways and means. It is impossible to forget, but provided we acknowledge that those who come after us are the only people who really matter, that mindfulness of the future should guide our steps, then we can put the past behind us and advance together, in step, towards that new age to which all aspire.

Sharing, talking together, respecting other people and our environment, all the avenues leading to a future commensurate with the human condition meet at the same crossroads, that represented by democracy. Civil society has to take charge of its own destiny, with the state, hitherto all-powerful and omnipresent, contenting itself from now on with the role of watchful guardian, ensuring compliance with the rules that society itself has chosen. ■

UNESCO IN ACTION
HERITAGE

BUTRINTI *rediscovered*

by Zija Xholi



In Albania, archaeologists have rescued a great city of the Ancient World from the mud and vegetation that concealed it for centuries

ALBANIA has witnessed the passing of a wide variety of civilizations. From Antiquity to the beginning of the twentieth century, successive domination by the Roman, Byzantine and Ottoman empires has left its traces. The city of Bothrota—Butrinti in Albanian—is one of the fragments which form the fabric of Albania's ancient cultural landscape, in the south-west of the Balkan peninsula.

Nestling in the highlands in the far south of the country and surrounded by dense vegetation, Butrinti was doubly protected by nature and by the fortifications which its inhabitants built in ancient times. However, this was not sufficient to isolate the city from the rest of the world. Less than ten kilometres from the island of Corfu, Butrinti was linked to the Mediterranean by the Vivari canal, which ran from the Butrinti Lake to the Ionian Sea.

The proximity of the sea and the lake, the gentle climate and the beauty of the surrounding countryside provided a splendid environment for the foundation of a city. In taking advantage of this site, the architects of the past constructed what was to become one of the major maritime and commercial

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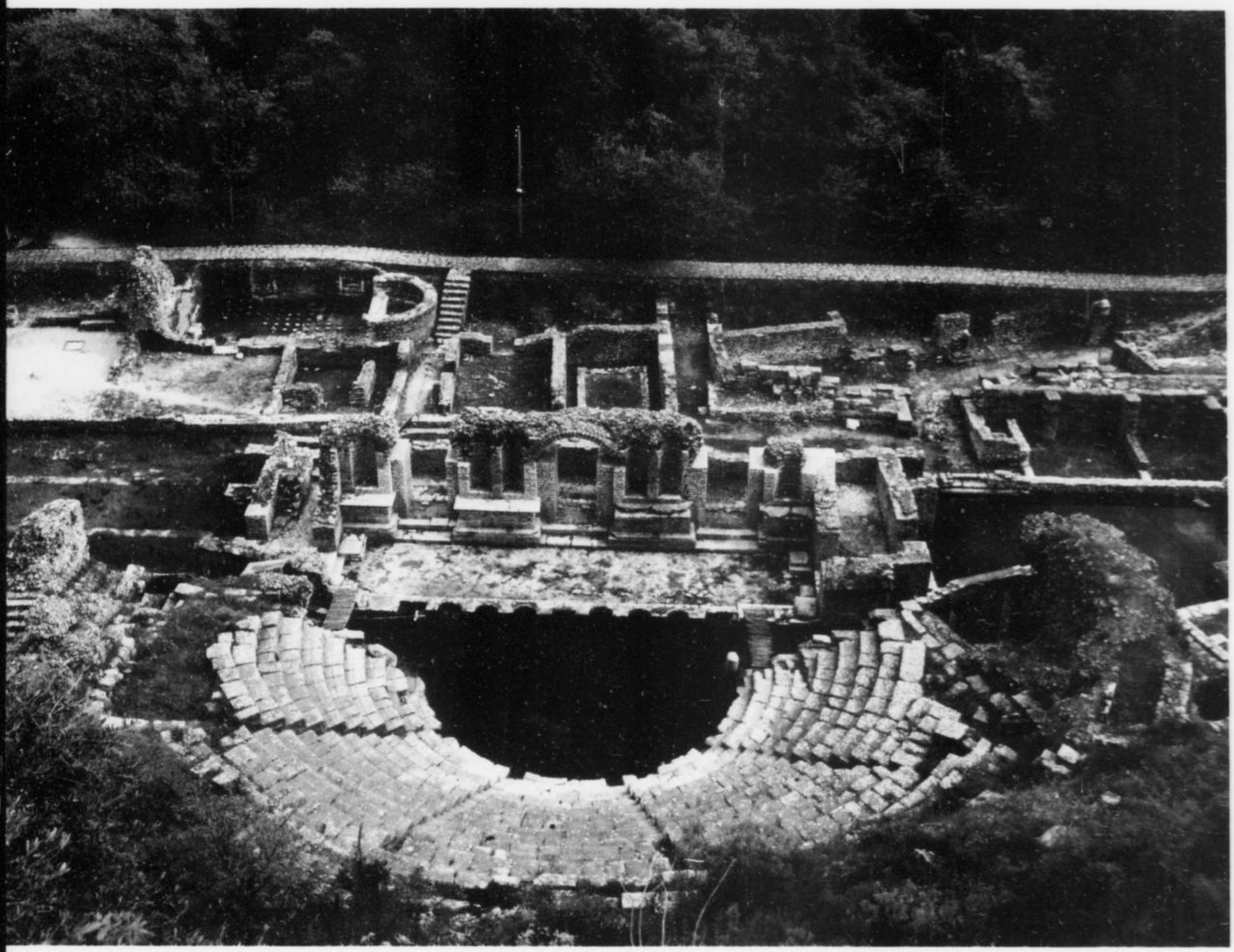

Above, the ruins of the amphitheatre (4th-3rd century B.C.). In background, remains of houses with colonnaded courtyards.
Opposite page, the baptistry (4th-6th century) with its double row of granite columns and mosaic floor.
Right, a statue belonging to the school of Praxiteles unearthed at Butrinti.

centres of the Ancient World. Butrinti reached the height of its glory in the fourth century B.C., at which time the city numbered 10,000 inhabitants.

The sight of the fortifications alone, which date from the sixth century B.C., evokes the military and economic potential of the city at that time. The hill on which the acropolis stands is encircled by a wall built of huge stone blocks. In places this wall is two metres high and 3.5 metres wide.

The amphitheatre, dating from the third century B.C., bears witness to the cultural riches of the city. The stone banks of seating, of which twenty-three rows have been preserved, would have held an audience of 1,500. The theatre is situated at the foot of the acropolis, close by two temples, one of which is dedicated to Asclepios, the Greek god of medicine, who was worshipped by the city's inhabitants. Approximately thirty inscriptions, almost all in ancient Greek, carved in the western façade of this temple, and another hundred or so found on a tower which was rebuilt in the 1st century B.C., are the only examples of writing discovered in Butrinti. These inscriptions are mainly concerned with the liberation of slaves.

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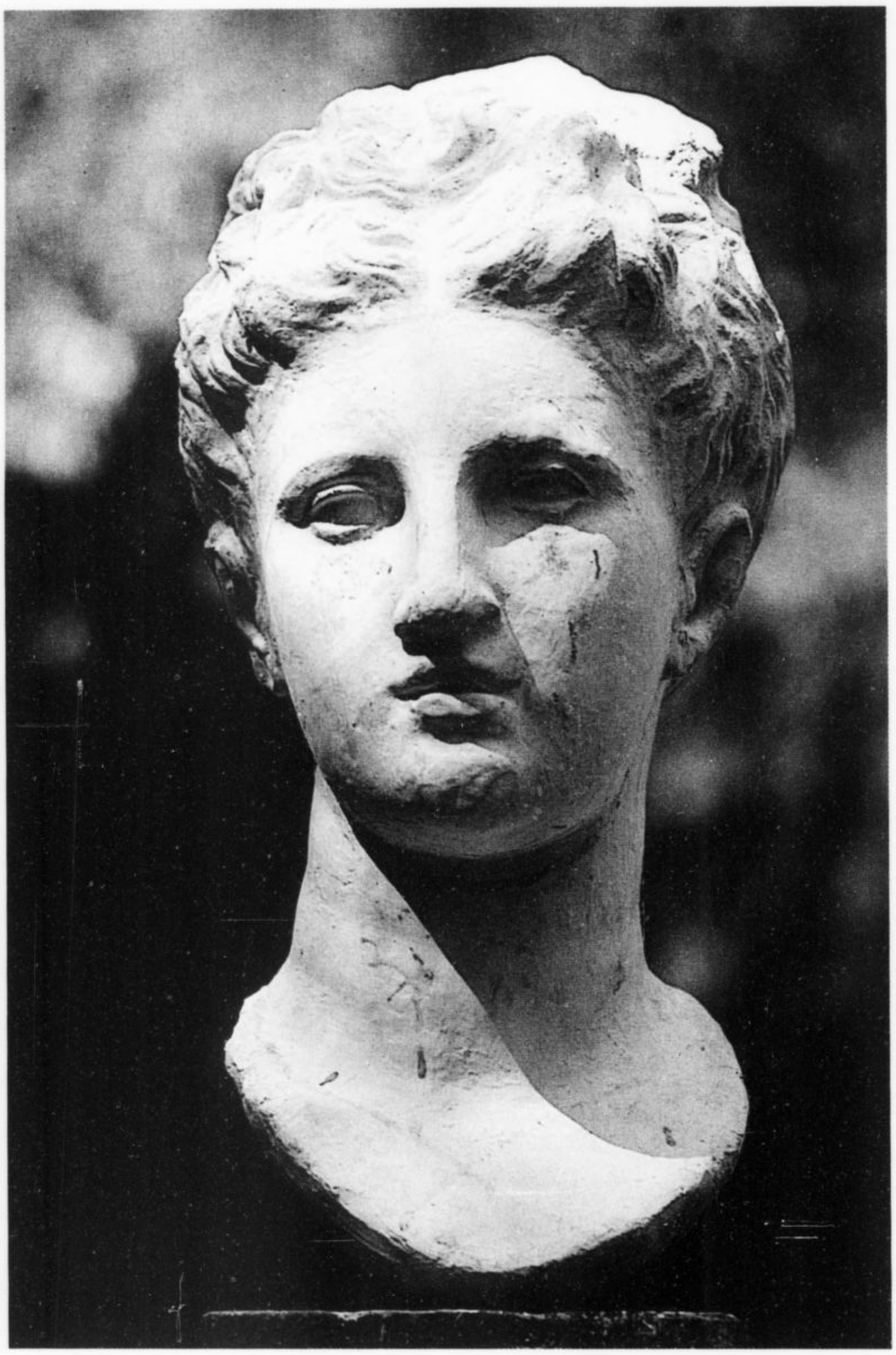


Head of Apollo (4th century B.C.) known as the "Goddess of Butrinti".

Excavations have brought to light many objects—plates, vases, ceramic candlesticks—as well as sculptures, including a remarkable "Goddess of Butrinti", which seems to completely embody, in the perfection of its features, the Greek ideal of physical beauty.

The ramparts served to remind the inhabitants of their peaceful life and the uncertainty of their future. For centuries, the walls faithfully defended Butrinti. But no wall is invincible, and these huge blocks of stone finally ceded to the assault of the Roman legions which landed on the Adriatic and Ionian shores in the second century B.C. Under the rule of the occupiers, Butrinti was to fall slowly into decadence. Unlike Dyrrachium and Apollonia, cities comfortably situated on the roads joining Rome to the East, which experienced a wave of prosperity, Butrinti—far from the major road links—was at the mercy of the whims of patricians and senators whose sole concern was achieving rapid personal gain.

In spite of this, three monumental fountains, three public baths, a gymnasium decorated with mosaics, and especially the aqueduct constructed during the reign of Augustus, prove that the site was not completely abandoned. Augustus also oversaw the reconstruction of all the ancient city walls and the erection of new fortifications. He accorded Butrinti the status of a colony, and it was at this time that the city minted its first coins.

Christianity brought new life to Butrinti. The palaeo-Christian period adorned the city with two basilicas and a baptistry, which is among the most beautiful in the Mediterranean region. Sixteen granite columns, forming two concentric circles, support the roof of the main hall. The floor is paved with a magnificent mosaic representing the Tree of Life and decorated with medallions embellished with animal motifs.

But this was to be a mere respite. Barbarian incursions and Norman raids in the eleventh century, a catastrophic earthquake in 1153, conquest by the Venetians in 1386, the subterranean infiltration of water and the subsequent epidemics completed the ruin of the city and forced the inhabitants to flee. Butrinti was buried in silence and oblivion. Throughout the occupation by the Ottoman Empire, from the fifteenth to the twentieth centuries, the city remained in deep slumber. The waters covered Butrinti in mud, and an abundant vegetation completely hid the remains from view.

It was not until the beginning of the twentieth century that systematic excavations were carried out at Butrinti by the Italian archaeologist I. Ugolini, followed by his compatriots P. Marconi and D. Mustili. Between 1928 and 1941, the ground was cleared and the ancient city gradually began to reveal its hidden treasures.

Following the liberation of Albania in 1944, Albanian archaeologists undertook more ambitious excavations. In turn, the ramparts, the acropolis, the agora, the amphitheatre, the temples, public baths and private residences re-emerged into the light of day. The entire city arose, almost intact, under the fascinated gaze of the archaeologists. The mud and vegetation that covered Butrinti had protected it from the natural and human ravages of time.

Today, this rediscovered city represents a unique cultural treasure whose value far surpasses national frontiers. The importance of Butrinti can be gauged from its inclusion in 1992 on UNESCO's World Heritage List. ■

Martin Luther King

ANNIVERSARY

Death, where is thy sting ?

by Edouard J. Maunick

MARTIN Luther King, Jr., who was born on 15 January 1929, would have been seventy-five years old this year. He died, aged less than forty, assassinated in Memphis, Tennessee, on 4 April 1968.

Anniversaries have a definite role to play in the mental calendar. With each passing year, events which have stamped a particular mark on the history of humanity resurface from the shadowy pool of memory. However, there is no doubt that some of the events and public figures recalled by a particular date speak to us independently of such anniversaries, moving through our daily lives and conditioning, in some way, our present circumstances. They are not waiting to pop out from the next page of our diaries. They are ever present, challenging us. Thus it is with the life and death of Martin Luther King.

As is the case with a number of other exceptional public figures, circumstances in the closing years of this century are such that the fate of this son of black America is again becoming topical as a landmark and an inspiration. It is tempting to echo the words of Albert Dürer who, four centuries earlier—believing Martin Luther to have been killed following the Diet of Worms—wrote in his journal on 17 May 1521: "O Lord, would that you might give us such another man as this!"

"Such another man" as Martin Luther King would be a warrior of non-violence, one who sought his weapons in Gandhi's armoury, to wage war without sword, bullet or bomb. During a voyage to India in February and March 1959, on the invitation of Pandit Nehru, Martin Luther King and his wife Coretta visited New Delhi to add a wreath to the carpet of flowers permanently adorning the sanctuary where Mahatma Gandhi was cremated. "I may travel to other countries as a tourist," he told journalists, "but I travel to India as a pilgrim." These were flowers of gratitude to a man who stood up against the staunch defenders of the caste system in a sub-continent steeped in almost unbearable poverty, a man who dared to raise the Untouchables to the rank of *Harijans* (Children of God). Was this not precisely the same cause as that to which Martin Luther King strove to devote himself: ensuring that the blacks of the United States should not be considered as inferiors or even pariahs?

In New York, shortly before this journey, while he was signing copies of his book *Stride Toward Freedom* in a department store, a mentally-deranged forty-five-year-old black woman had struck Martin Luther King in the chest with an ornamental paper-knife, grazing his aorta. Had the victim so much as sneezed, the aorta would have punctured, leading to certain death. This was only one of numerous attacks which dogged the career of this remarkable pastor, who—in December 1955, at the age of twenty-six, on hearing that another black woman, Rosa Parks, had been arrested in Montgomery, Alabama, for refusing to give up her seat on a bus to a white—had decided to devote himself to freeing his community from the scorn, derision and shame which had been heaped upon it. Freedom became his watchword and rallying call.

Surrounded by friends, all of whom believed as he did that "the time for silence is past, the time has come to speak out", he leapt into the fray, armed by the memory of the Martin Luther who, seeking to lead his companions out of the Babylonian Captivity (the title of one of Luther's treatises), wrote these words which must have been familiar to Martin Luther King: "Would it not be against Nature if, a fire being declared, each citizen were to remain still and let the fire wreak its havoc, solely because he is not Mayor of the city?"

The violence endured by Martin Luther King in thirteen years of campaigning included both physical and moral attacks: he was to be arrested several times, beaten, imprisoned, prosecuted for "incitation to riot" and fraud, accused of treason against America by those who opposed his stance on the Bay of Pigs operation in Cuba and the Viet Nam war, and "to spice things up" Martin Luther King's opponents circulated tapes made with the use of hidden microphones, even sending to his wife tape-recordings of high-spirited

Martin Luther King in 1966, two years before he was assassinated in Memphis (Tennessee).

evenings spent while on tour in the southern States.

He was to be spared no form of attack. But nothing was able to break his resolve to build a new America, the land of the famous "dream" which he described on 28 August 1963 to a crowd of 200,000 people—black and white—assembled in Washington D.C., and to millions of Americans at home, sitting in front of their radio and television sets. Martin Luther King's words on that day will remain forever etched in the memory of people in all corners of the world: North, South, East and West.

Indeed, nothing could halt the war declared by Martin Luther King in the name of his fellow black Americans. He fought the good fight to the end, stubbornly rejecting violence, trusting in the civil disobedience he had learned from Henri David Thoreau, who had himself been influenced by the same Hindu mystics who had nourished the sublime non-violence of Mahatma Gandhi, the inspiration for Martin Luther King's approach to his task. Nothing could stop him, until a bullet fired from a rifle struck him down on the evening of 4 April 1968, sounding the death-knell of the man: "with the golden voice, melodious as the flutes of angels/ A voice of blazing brass which rings out over Sodom and Admah."* ■

* L.S. Senghor: Elegy for Martin Luther King.

EDOUARD J. MAUNICK, Mauritian poet and writer, former Director of the UNESCO Collection of Representative Works, is at present associate editor of the magazine *Jeune Afrique*. He is the author of some fifteen works, including *Ensoleillé vif*, which won the Prix Apollinaire in 1977, *Anthologies personnelles* (Actes Sud, Paris, 1984) and *Paroles pour solder la mer* (Gallimard, Paris, 1989).

Thomas Mann
The downfall of idealism

In this second excerpt from the address he gave in 1935 at a meeting organized in Nice by the International Institute of Intellectual Co-operation on the theme of the education of modern man (see previous issue), the German writer Thomas Mann has harsh words for the moral waywardness of the masses and their betrayal of the intellect. This text, written almost sixty years ago at the time of the rise of Nazism, is in some ways still strikingly topical. The third and final instalment will appear in next month's issue.

THE First World War was not the prime cause of the impoverishment of European civilization. It only accelerated and accentuated it. It was not the war that threw up the gigantic wave of eccentric barbarity and demagogical, primitive brutality that is overwhelming the world; it only enlarged and intensified its blind rage. Modern man is both the victim and the product of the disorganized and confusing as well as exciting and exhilarating impressions that assail him. The fantastic development of technological expertise with its triumphs and disasters, the blare and thrills of sporting records, the exaggerated importance and remuneration given to crowd-drawing "stars", the boxing matches fought for fabulous prizes and held in vast arenas before huge crowds—these are some of the characteristic features of our time, along with the decadence and decline of concepts that are edifying and salutary in their severity, such as culture, the mind, art and ideas. These are the conceptions of the bourgeois age, the glad rags of nineteenth-century idealism.

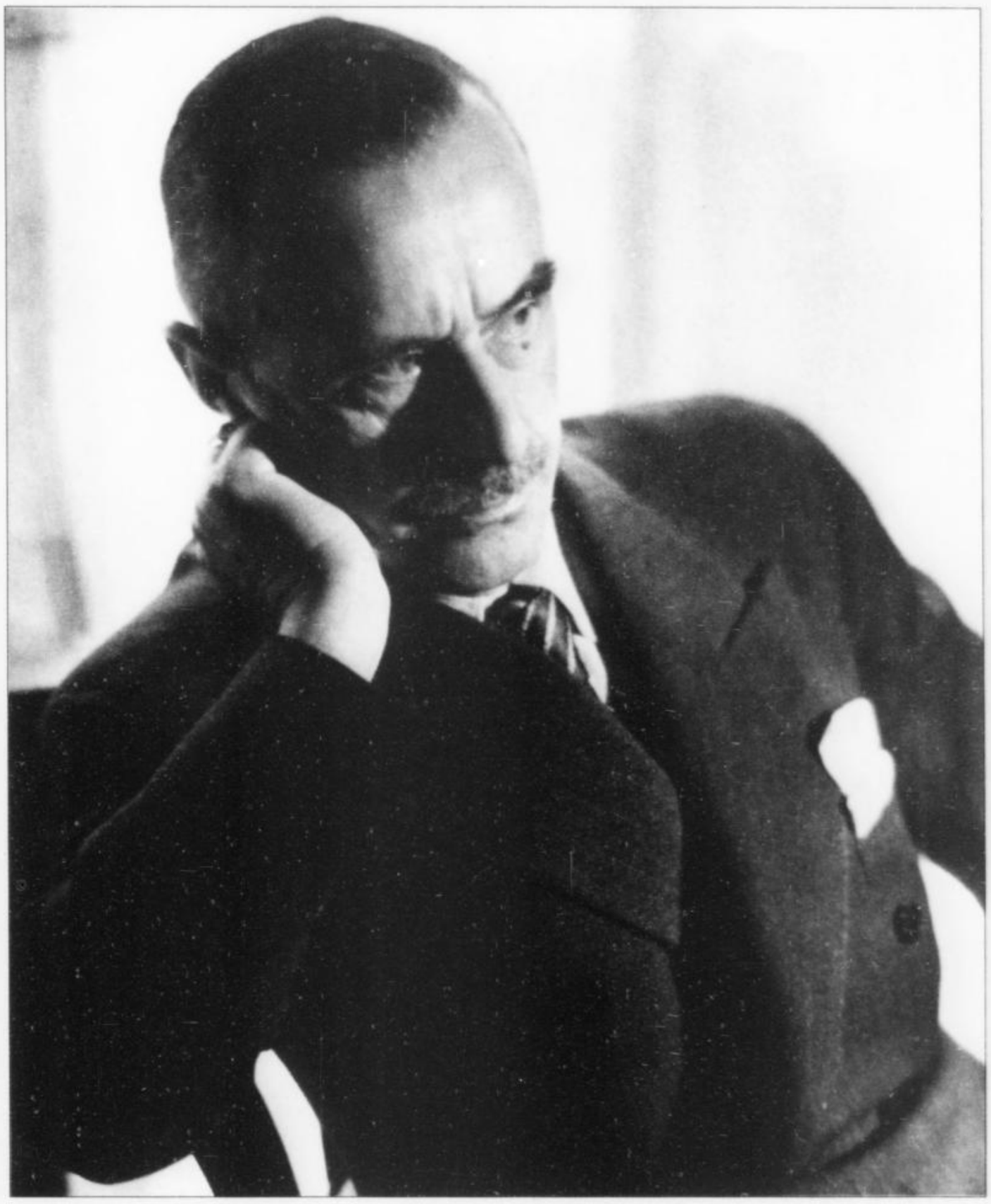
In fact the nineteenth century was above all a period of idealism. With a certain emotion we see today just how idealistic it was. It not only believed in the benefits of liberal democracy but in socialism, a socialism that would elevate the masses, instruct them and have them participate in the advantages of science, culture and art, in short, in civilization. Today we are convinced that it is more important and also easier to dominate the masses by increasingly perfecting the crude art of using their psychology, i.e. by replacing their education with propaganda, not, it would seem, without the intimate consent of the masses, who can easily be swayed by dynamic propaganda that seems more modern and more attractive to them than any educational idea. The masses are organizable, and it can be seen that they always accept organization gratefully, whatever the spirit behind it may be, even if it is the spirit of violence. Violence is a principle that greatly simplifies things; it is no surprise that it should be understood by the masses.

If these modern masses were merely primitive, if they only consisted of happy, naive barbarians, it would be possible to get along with them and hope for something, but they have two qualities that make them quite simply appalling: they are sentimental, and they are disastrously philosophical. The mind of the masses, imbued with noisy modernism as it is, speaks in romantic jargon. It talks of race, the earth and blood, a stack of old ideas both traditional and pious. . . . The result is a hypocritical blend of sentimentality and popular stupidity bathed in mawkishness, a triumphant combination that characterizes and defines our times.

THE IDEALISTIC REBELLION

Things are even worse concerning the masses' philosophical system. Of course, they didn't invent it; it has trickled down to them little by little from the intellectual spheres above. The role played by the mind for several decades now has been extremely remarkable. It has turned against itself, has begun to indulge in irony at its own expense and has pathetically abdicated in favour of life and the generative forces of the unconscious, of the dynamic, and of the subterranean deities, those august and dark creative forces whose maternal breast is the sacred source of all life. We all know of this attack by the mind against itself, against reason that it has pilloried by accusing it of destroying life: it is a bold and fascinating spectacle,

Text selected and presented by Edgardo Canton



Thomas Mann in 1936.

but apt to engender confusion so that perhaps it would have been better not to let the general public in.

It is clear that the struggle against idealism was started by idealism. The nineteenth century was so bitterly in love with truth that through Ibsen's voice it even wanted to recognize the "lie of life" as indispensable. But it is easy to see that there is a big difference between the person who accepts the lie because of painful pessimism and bitter irony and the person who accepts it because of a lack of love for the truth. Today this difference is no longer apparent to everyone: Nietzsche's polemical virulence against Platonism, Socraticism and Christianity was the polemic of a man more like Pascal than Cesare Borgia or Machiavelli. It was the ascetic victory of a Christian-born man over himself. Marx's fight against German idealism's conception of truth and morality was not without analogies to Nietzsche's. Marx undertook the struggle because of idealism, because of love for a new truth and justice and not out of contempt for the mind.

This contempt was to be expressed in the decades that romanticized the idealistic rebellion against idealism, thereby opening up dangerous possibilities of popularity. Those who professed these theories neither saw nor cared about the dangers to which humanity and civilization are exposed by any intellectual attack on the mind, about the seeds of latent reaction in a revolution of this sort, about the dark possibilities of abuse they can lead to when, transposed into reality, they become in the bat of an eyelid the charter for all kinds of "spiritualism", for all kinds of human indignity, for impudent contempt for truth, freedom, justice and honour. We are forced to observe that the mind has been lacking in a sense of responsibility and has not understood that morality and mind go together, that their rise and fall happen simultaneously and that contempt for reason leads to moral licence. Thousands of proponents of irrationalism have not bothered to find out whether or not they are leading the people into moral impoverishment and training them to be apathetic towards all kinds of atrocities.

THE HULLABALLOO OF THE FAIR

The new masses heard rumours about the sensational downfall of the mind and reason that had taken place in the higher spheres; they learned that this was the latest thing, and they did not seem very surprised about it, for movements of this kind had already long been rampant among them. Many things that would never have been accepted by the more demanding humanity of the nineteenth century had again become possible, had once more insinuated themselves into our habits, owing to our age's fairground hullaballoo: all kinds of occult sciences, half-sciences and quackery, obscure sects and stupid back-street religions, bare-faced bluffing, blind and simple faith and the airs and graces of an old charlatan, all these aberrations had their day, drew in the masses and set the tone of the times. Many cultivated men saw these things neither as a vulgar, modernistic hotchpotch nor as the degeneration of civilization. Instead they mystically proclaimed that we were witnessing the resurrection of deep-rooted vital forces and venerable popular feelings. The ground was even prepared for the most absurd and the most shameful of mass superstitions. And this was not the vague and thoughtless superstition of the past, but a modern democratic superstition based on the right of every person to think, in short a superstition that went with "philosophical ideas". ■

(TO BE CONTINUED)

RECENT RECORDINGS

by Isabelle Leymarie

JAZZ

Carmen McRae Sings Great American Songwriters
CD MCA GRP 16312
This disc contains a selection of songs by Gershwin, Cole Porter, Jerome Kern, Rodgers & Hart and other composers, recorded in the 1950s. McRae is sometimes accompanied by a piano and guitar, sometimes by big bands with string sections. Some of her accompanists are outstanding instrumentalists, like Kenny Clarke and Tadd Dameron, but for the most part the backing is provided by session artists. She interprets some of the great jazz standards, "My Romance", "My Funny Valentine" and "Summertime", with her wonderful clarity. In the same way that Billie Holiday is famous for conveying emotion, Sarah Vaughan for her vibrato and Ella Fitzgerald for her brilliant improvisations, McRae is famous for her diction. Every syllable is crystal-clear and different from the last. A jazz classic.

LEE KONITZ. ***Rhapsody***
Konitz (alto sax), Helen Merrill, Jay Clayton (vocals), Peggy Stern, Paul Bley (piano), Gary Peacock, Ben Allison (bass), and others.
CD KICJ 174
In terms of style, this is "white jazz", with the emphasis not on swing but on intimacy, with each piece being performed as if it was chamber music. Inventiveness is omnipresent, especially in Jay Clayton's

vocals and the harmonies of Stern and Bley. Clark Terry, the only black musician on these tracks, contributes a stronger beat in his duet with Konitz on "Flyin'—Mumbles and Jumbles". His individual sound spices up Konitz's more flowing, "classic" (in the academic sense of the word) style.

MUSIC FROM AROUND THE WORLD

CUARTETO PATRIA.
A una Coqueta
CD Corasón COCD106
Hailing from Santiago de Cuba, in Oriente province, cradle of the *bolero* and the *son*, the Cuarteto Patria, led by Eliades Ochoa, is made up of two guitars, bongos and a double bass. A traditional group that has kept its country flavour, it performs pieces by Cuba's leading composers of popular music: Luis Marquetti, Francisco Repilado, Miguel Matamoros, Manuel Corona and Lorenzo Hierrezuelo. Easy listening though the music may be, it is not as simple as it appears at first hearing, as may be judged from the guitar and bongo solos, frequently off-beat in relation to the basic rhythm.

VIET NAM. ***Tradition of the South***
Anthology of Traditional Music Collection
CD Corasón COCD106
Although Viet Nam is now open to tourism and has figured in several recent films, its ineffably beautiful music remains a great mystery to most listeners. This disc offers a series of recordings of

"entertainment" music belonging to the tradition of the southern part of the country, but affected by various influences from elsewhere. The music, improvised and here played on a *dan tranh*, a sixteen-string zither, a *ty ba*, rather like an old Chinese *pipa*, and a *song lang*, a hardwood block, is governed by modes and "modal nuances" that express, as in India, various emotions: joy, serenity, solemnity, calm and sadness. This is one of the most flourishing of the musical traditions in southeast Asia.

TURKEY. ***L'art vivant de Talip Özkan***
CD Ocora C 580047
Less harsh than some classical Arab music, tempered by influences from the heartland of Asia, Turkish melodies inevitably recall the opulence of *The Thousand and One Nights*, and Turks are in general fervent lovers of dancing and music. An expert in his country's oral heritage, Talip Özkan is a virtuoso of the long-necked lutes, the *divan saz* and the *tambura*. Here he offers us music from various regions—Anatolia, Edirne, Aydin, the northeast and the border region between Turkey and Iran—seldom heard outside Turkey, enabling us to enjoy all the nuances of this fascinating world of sound.

GERARD ZUCHETTO/MICHEL ROUSSET. ***L'Hérétique.***
Poems by René Nelli
CD Gallo 765
France is at present witnessing a renaissance of regional languages and dialects, one of which is Occitan, famous in days gone by for its courtly literature. Occitan remained a living language for a long time: my grandmother, born in Carcassonne, often spoke it to me and knew countless old poems and songs in the language. The Centre for Popular Music in Céret has undertaken to collect the vanishing folklore of the French southwest. Keenly interested in the troubadours and the Cathars, René Nelli is, with his strong, dense language, one of the great Occitan poets. The singer Zuchetto and the pianist Michel Rousset, with a contribution from Dominique Regef on the cello, rebeck and *israj*, do an admirable job of setting these poems in Occitan and French to music. The booklet that comes with the disc contains translations of them into several languages.

CLASSICAL MUSIC

CAMILLE SAINT-SAENS.
La Muse et le Poète.
Ensemble Orchestral de Paris directed by Jean-Jacques Kantorow
CD EMI Classics 0777 7 54913 2 6.
The Ensemble Orchestral de Paris and several soloists—the violinist Patrice Fontanarosa, the cellist Gary Hoffman, the flautist Clara Novakova and the clarinettist Richard Vieille—play several of Saint-Saëns' vibrant, refined and romantic works: the *Odelette* for flute and orchestra, the *Tarentelle* for flute, clarinet and orchestra and the Suite for orchestra with its Prelude, Sarabande, Gavotte, Romance and Finale, as well as the Romance for flute and orchestra. The texture is variable: the music is sometimes compact and intense as if moved by surging passion, sometimes sparkling with subtle chromatic effects, as in the barcarolle, *Une nuit à Lisbonne*, dedicated to Don Luiz, King of Portugal. ■

by Edgar Reichmann

On the trail of Fernão Mendes Pinto

When Renaissance Europe discovered the distant East

'Peregrinations of Fernão Mendes Pinto, in which he relates the very numerous and very strange things which he saw and heard in the Kingdoms of China and also of Tartaria, of Sornau, which is commonly known as Siam, in those of Calaminhâ, of Pegu, of Martaban and in many other Kingdoms and Realms of the Orient, of which little or nothing is known in Occident. And also relates the many and exceptional adventures which befell him and many other persons. . . ." Thus reads the title page of a monumental work, first published in Lisbon in 1614, which was subsequently translated from Portuguese into many other languages and published in various editions throughout the world. Today, there are signs of a resurgence of interest in this remarkable best-seller of the seventeenth and eighteenth centuries, as evidenced by recent translations into American English, French and Japanese.

Who exactly was Fernão Mendes Pinto? Most reference books have little to say about him. A contemporary of another poet of the warm seas, Luis de Camoens, he explored the East Indies and published an account of his travels, *Peregrinação* (1614): this is all we are told. The index of place names in the most recent French edition of this work—translated by Robert Viale and containing an illuminating commentary by the translator—yields further information regarding the mysteriously named places visited by this writer-adventurer. Thus Calaminhâ, initially thought to be Tibet, has been identified as Laos; Pegu was the capital of Burma, and Martaban was a very ancient city in the same country.

Fernão Mendes Pinto's life was that of a character in a baroque novel. It has similarities with that of the French explorer Henri de Monfreid in this century. Probably from a modest background, talented and cultured, at the age of twenty-seven Pinto left his position in an aristocratic Portuguese household and set out into the unknown to make his fortune. He did not return to his homeland for more than two decades, during which time he explored the horn of Africa, the coast of Arabia, the fabled land of India, and Southeast Asia, China and Japan. After returning to Portugal, he obtained a royal pension late in life and devoted his twilight years to the writing of his book. This man who was at various times a trafficker and a slave, condemned to death and reprieved, an ambassador, a missionary and a friend of the Jesuit St. Francis Xavier, is, because of his epic story-telling genius, an exemplary witness of the way in which Renaissance Europe perceived other civilizations.

A THIRST FOR CONQUEST

Pinto does not depict the Portuguese as superior to the peoples he discovers. On the contrary, with the exception of their religious practices and military weakness, he admires the munificence of these distant civilizations—particularly China—to the extent of indicating, by contrast, the weaknesses of the West, especially in the areas of social organization, justice and economics. As Robert Viale points out in his introduction, this is the account of a lucid, meticulous observer, who went so far as to count each and every wick in the 1,439 lamps in one temple he visited, but one who is also at pains to provide the reader with a full picture of whatever he is describing.

This thirst for detail and astonishing precision are by no means innocent, however. For Fernão Mendes Pinto, everything has a price, and the defensive weakness of the prosperous countries which he visits awaken in him the desire for mastery. As early as the Aviz dynasty (1385-1580), Portugal—this small country at the furthest western extremity of Europe—had established its first trading missions on the African coast. Portuguese navigators rounded the Cape of Good Hope in 1487, and founded a colonial empire in the Indies, of which Vasco da Gama became Viceroy. More than the metaphysical quest for an improbable grail, probably more than the thirst for knowledge, it was the attraction of great wealth—the fabrics, spices, precious wood, gold and gemstones which abounded on the Far Eastern shores—which made European caravels hasten to these hitherto unknown lands.

ENTHRALLING ADVENTURES

However, these travels also form a series of amazing adventures. The narrator recalls his youth prior to his departure, his discovery of India, and the harrowing demise of the King of Aaru (a now-extinct kingdom on the north-east coast of Sumatra). Among a host of other portraits, Fernão Mendes Pinto paints a picture of Beijing in the sixteenth century, "wherein the king of China holds his residence". The author also evokes "the cares which are dispensed to all infirm and needful persons", stating that "throughout the kingdom are to be found habitations destined for the poor", but also relates the way in which "the town of Martaban was sacked and destroyed and the manner whereby the Queen and many other women were subjected to manifold tortures".

The author condemns the religious hypocrisy of his compatriots, who cause harm by invoking the name of the Lord; he is horrified by the cruelties of the Inquisition. His "peregrinations" illustrate those of a humanity which wishes to progress, reaching beyond its limits and breaking away from the conditions imposed by the environment, to finally encounter the "Other". But at what cost? the reader is tempted to enquire, after turning the last of the 777 pages of this odyssey of the 1600s. The disappearance of the civilizations of the Andes and Central America, the depopulation of Africa by slave traders, the genocides which ran like a sore through the following centuries suggest that he who sets out in search of the "Other" without first taming his appetite for conquest and his lust for wealth runs the risk of losing himself on the way. ■

Fernão Mendes Pinto, *Pérégrination*, travel writings translated into French from the Portuguese and presented by Robert Viale, Collection Outre-mers, La Différence publishers, Paris, 1991. ISBN: 2-7291-0597-2.

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LETTERS TO THE EDITOR

WHEN THE SAHARA WAS A TROPICAL FOREST

In the article entitled "The dry lands" which appeared on page 11 of your January 1994 issue, I read that "arid and semi-arid regions are concentrated in two zones straddling the Tropics of Cancer and Capricorn, on each side of the Equator. The main cause of aridity is to be found in the circulation of the atmosphere above our revolving globe. The almost permanent ridges of high pressure that predominate around the 30°-latitude mark stop rain from forming."

I do not think that this has always been the case. Several million years ago, what is now the Sahara was apparently a tropical forest, which means that the explanation given for the present situation is invalid for such very ancient times. Is there any way of finding out about the climatic changes that have taken place since then?

JOSEPH EMPAIN
BRUSSELS (BELGIUM)

The general circulation of the atmosphere is an extremely complex phenomenon. It is true that the Sahara has experienced far less dry periods than today, as we know from the remarkable neolithic frescoes of Tassili N'Ajjer. These periods occurred not millions of years ago, but in the course of a rainy period following the most recent glaciations, less than 10,000 years ago. At that time the general circulation necessarily shifted. However, the explanation given, which takes account of the situation since the historic era, remains globally valid.

Michel Batisse

OUCH!

I was happy to see in your excellent November 1993 issue ("The Story of Numbers") a reference to my language, Breton. On page 10 there is a table showing ways of forming the number 18 in different languages. In Breton 18 is actually written *triwec'h* (and not "*tri-ouch*"! as you have it). Our Welsh brothers say *deunaw* (2 x 9), but also *un deg wyth* (1 x 10 + 8). The Celts of the Gaelic branch say *a h-ocht-déag* (8 + 10).

Thank you again for this allusion to Breton, a language which, while no longer openly attacked as it was for years, still has no official status . . .

ALAN ER HOULVENN
KERILIEU LANDAD (FRANCE)

A FAITHFUL READER

I have read the *Courier* since it began publication and have every issue except for the first one or two. I wonder whether you have many such faithful readers.

MARIE-HÉLENE ERNST
RUE DU CHATELARD
87370 SAINT-SULPICE-LAURIERE (FRANCE)

EMOTION IN ART

I agree with what Henry Christiaen said in his letter which appeared in the February issue of the *UNESCO Courier*. As an academically trained artist, I think, like him, that with the development of techniques for the mass production of images some emotions have become subdued, latent.

Turning to abstract geometric forms appears to be a result of fear—a retreat from reality—leading to a sharp deviation from life forms to a kind of cubistic art. And yet the photographer searches for design and balance in interpreting his emotions, as does the careful painter and brush artist.

I think a deliberate return to reality might result in a form of creation that encourages an understanding of the artistic message.

MILDRED BOHN
HOUSTON, TEXAS (U.S.A.)

FOR A CULTURE OF PEACE

I greatly appreciated the editorial of your October 1993 issue ("Time to Disarm") which mentions Lord Noel-Baker whom I had the good fortune to meet at a UNESCO symposium with Sean MacBride, and with whom I had warm relations until his death.

But I appreciated above all the "Appeal for non-violence" launched in that issue by the Director-General of UNESCO, Mr. Federico Mayor. I welcome the fact that he puts the accent on generosity, a necessary and sufficient condition for the creation of the culture of peace that he calls for in his interesting *Commentary*. It is admirable that he should find generosity "natural" for human beings, thereby showing himself to be a profound humanist.

I read with far less enthusiasm about the meeting between Goethe and Napoleon so brilliantly described by Paul Valéry (in the "Archives" feature). It seemed to me out of place in the *Courier*, since Napoleon belongs precisely to that culture of war whose end Mr. Mayor wishes to see.

MME M.C. CHARPY
ST.-TROPEZ (FRANCE)

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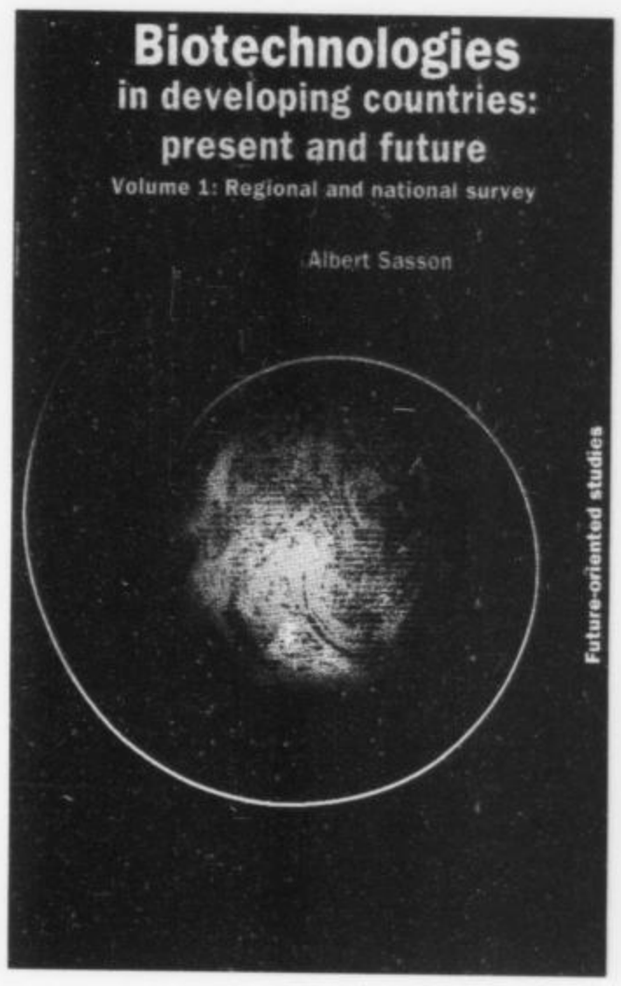

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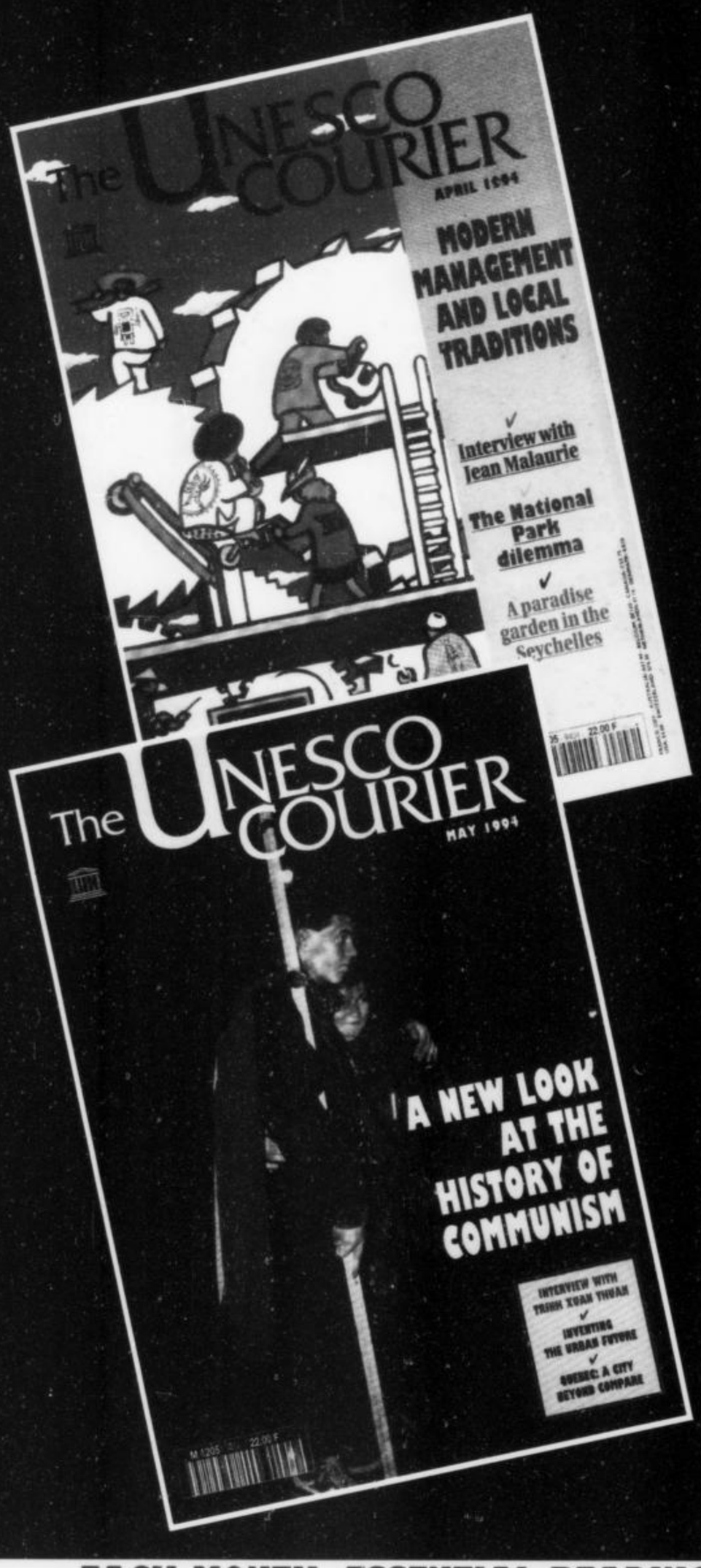

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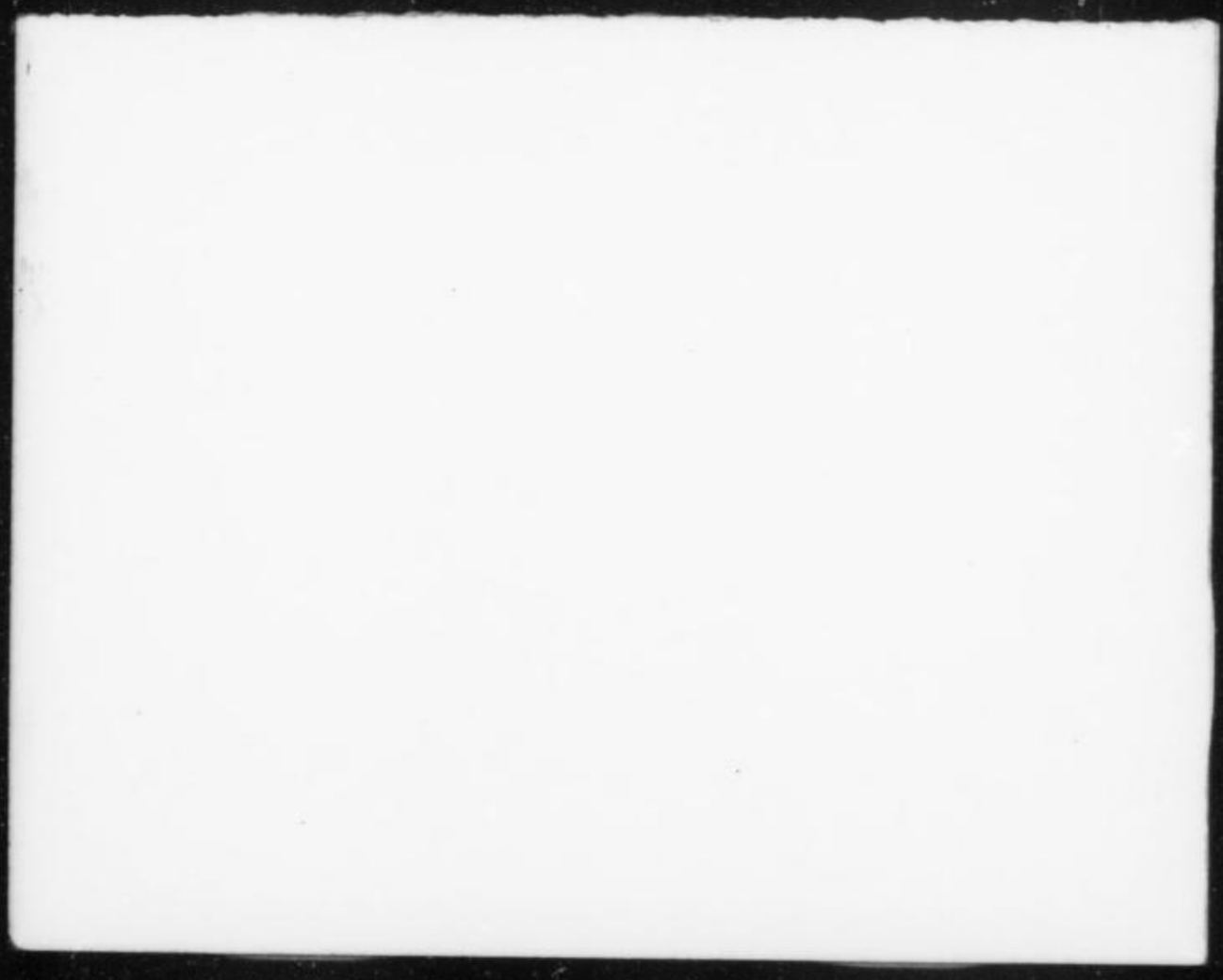
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